MAY 24 1943

ENGINEERING
NEWS-RECORD

AY 20, 1943

Plant Layout for Ship Construction

Garbage Disposal With a Kiln Furnace

Work-Saving Formulas for Engineers

Long Weir Increases Power from Niagara

ing veneer sheets for plywood — (See story inside)

The completion of this Sperry Gyroscope Company building adds another to the long list of important "war jobs" where Radiant Heating —and Byers Wrought Iron—are serving.

The system was engineered by Stone and Webster, and Alvord and Swift were the heating contractors. It was the first Radiant Heating installation for each concern. All coils were formed with a bending machine on the job, and field-welded into four unit assemblies, each individually controlled by Johnson Service Company thermostats. In situations where additional heating effect was needed in a given area, vertical panels (as shown in small illustration) were installed. The completed piping system was tested at 100-lbs. pressure for four hours, and in 19,000 feet of pipe only three minor leaks were revealed.

The coils were topped with 6-inches of concrete, poured while the coils were filled with water at 100°F. Finished floor will be bare, or linoleum covered. The heating medium is hot water at 110°F., provided by a heat exchanger and zone circulated by four Ingersoll-Rand fractional horsepower pumps.

The influence of proper heating upon production gives extra reason for checking Radiant Heating's advantages against the heating needs of any structure built today. It generally saves considerable metal, leaves all floor-space clear, and introduces no explosion hazards in dangerous operations.

Byers Wrought Iron for the "permanizes" these advantag its superior corrosion resista has been demonstrated in hundr of applications where service ditions were similar. Its ther properties are excellent; and it be readily formed and welded

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COMING NEXT

• New Horizons for Water Service are explored in a 16-page report to be published in the June 3 issue. Designed to aid municipal administrators, engineers, contractors and manufacturers in making an appraisal of postwar conditions in the field of water supply, the report analyzes all phases of activity. Here you will find an estimate of physical deficiencies and the amount of work to be anticipated, a method for making an evaluation of community needs, statements from manufacturers on postwar equipment, and a timetable of future activity. Other parts of the report deal with personnel relations, unionization, fiscal policies and regional water supply questions. This thought-inspiring discussion is another in the special *Engineering News-Record* series of reports on matters of wide public interest.

• The Navy's Bureau of Yards and Docks, and its civilian engineers and contractors, have scored another outstanding achievement in construction of primary air training stations for the thousands of students being turned out by its preflight schools. To meet the dead line on a rush program, and save critical materials, too, required ingenuity in both design and construction. One of the first of eighteen stations now in use will be described in *ENR* for June 3.

LOOKING AHEAD

• A war inspired design, using 40-ft. timber beams in combination with precast concrete columns to provide a rigid frame for a one-story industrial plant, reduced steel requirements to 3.5 lb. per sq. ft. of building area, permitted the advantage of wide column spacing and 25-ft. headroom above an overhead crane. These and other features will be described in an early issue.

• Laboratory accuracy in the concrete mixing plant has long been the goal of the concrete engineer. "Dollar Economies in Concrete Proportioning"—an article to appear in a forthcoming issue of *ENR*—brings to light some pertinent facts relative to a precision control method that will prove of exceptional interest to concrete engineers, both in the office and in the field.

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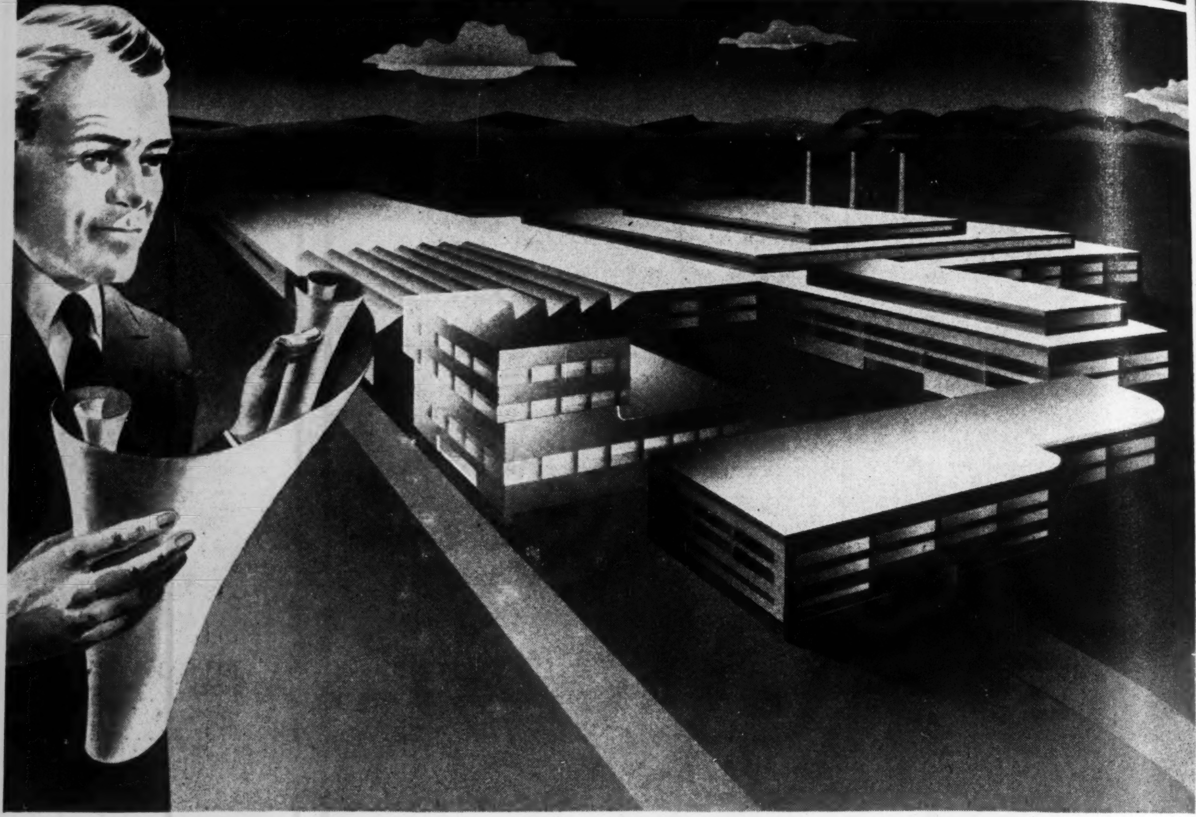

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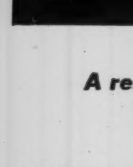

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he Week In Engineering and Construction

NGINEERING NEWS-RECORD • MAY 20, 1943 • VOLUME 130 • NUMBER 20

Two large dams in Germany breached by British bombers

Moehne Dam at the head of the Ruhr Valley and Eder Dam on the Weser River system both ruptured by large mines dropped from low altitude by British bombers.

Two of the largest storage dams in urope were blasted by mines dropped nday night from low-flying Lancasters the British Royal Air Force. Selected, ndoubtedly, because of their importance key dams of storage and navigation stems, the structures were attacked in manner calculated to release a large rt of the water behind them. The sulting flood in the Ruhr valley took t the Moehne power house and is reported to have done serious damage to her power installations, bridges, railads and industries throughout the ngth of the valley. Like damage is ported from the Weser River Valley.

A large storage dam

The Moehne Dam is a 132-ft. high 145 ft. long, gravity-type, stone-masonry structure arched in plan, with a base 113 ft. thick and a non-overflow crest ft. thick. The spillway is in a side channel.

From pictures made by the flyers the breach in Moehne Dam is more than 00 ft. long. The cut is immediately above the power house which is said to have been completely destroyed. The Moehne reservoir, of about 110,000 acre-ft. storage capacity, was an important part of the water supply of the Ruhr valley. Built about 1912, it furnishes water for not less than 11 major hydroelectric installations, 300 water works and important industrial developments. Water supply in this area is so critical during the summer that this loss of storage might make the River Ruhr unnavigable, thus contributing further to overloading of the railway system in this important industrial area.

Damage to Eder Dam

Less is known of the damage to Eder Dam in the Weser River Valley. The dam creates a reservoir of 164,000 acre-ft., said to be the largest in Europe. Built between 1908 and 1914, the masonry structure is 157 ft. high with a crest width of 19 ft. and a length of 1,312 ft. Width at the base is about 120 ft. It is a non-overflow structure with flood discharge through openings in the dam.

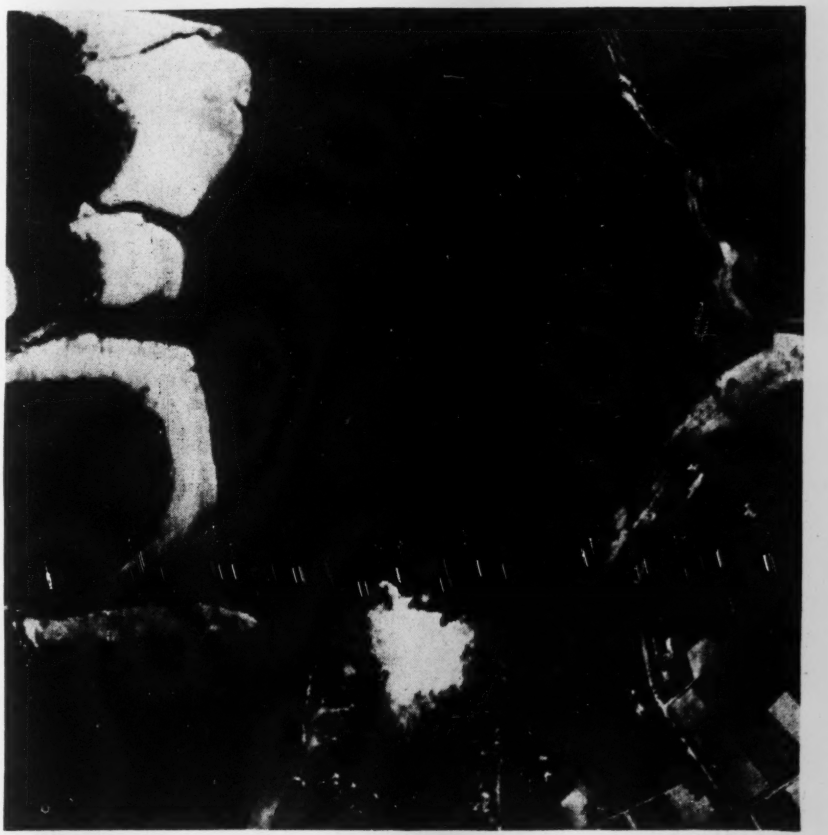
Storage is used to generate power at two plants at the dam and two other plants, one a pumped-storage, peak-load installation nearby. All may have been put out of service by the flood. Stored water also is used to make navigation possible along the Weser River during the summer months.

A special dispatch to the *New York Times* states that RAF crews have been planning and practicing for the raid for months. Mines instead of bombs were used, the flyers coming down to within 100 ft. of their objectives to drop the 1,500 lb. of explosives as near as possible to the point selected for attack.

At least two hits

The crews who attacked the Moehne Dam said the first mine caused part of the top of the dam to break away and that another mine, striking squarely, caused further crumbling. Water pour-

(*Continued on page* 55)



Acme Radiophoto

Moehne Dam after it had been breached by the RAF bombers shows dimly as a curved structure across the middle foreground of this picture, behind the white area made by the water spilling through the opening in the dam. The power house directly below the breach in the dam has completely disappeared. More clearly seen is the exposed shoreline of the drained reservoir, which was shown by earlier photographs to be full before the attack.

Heavy rains cause high floods over large area in the Mid-western states

Record floods develop in the lower valley of the Arkansas River. Many streams over their banks in Arkansas, Oklahoma, Missouri, Kansas, Illinois and Indiana

Heavy rains over an area extending from the western slopes of the Ozark Mountains east to Michigan put many streams over their banks and caused a record flood in the central and lower part of the Arkansas River. At Fort Smith, Ark., the flood crest on May 13 was 3.7 ft. above the previous high record. Between Fort Smith and Little Rock strenuous efforts were made to save the levees, army engineers joining forces with the local levee districts, but the levees were over-topped and breached in four places. This reduced the crest somewhat before it reached Little Rock on May 16. Little Rock is protected by a new flood wall and pumping station. The crest reached Pine Bluff, Ark., on May 17, but by that time was largely under control.

Engineer troops from Camp Clairborne and Camp Robinson and from the Pine Bluff Arsenal are patrolling the levees and assisting in reinforcing the weak points.

Six persons were reported to have lost their lives in Oklahoma and 22 were reported as missing, including seven soldiers who were helping to rescue people from flooded lowlands.

Troops bridge Arkansas

At Fort Smith a water main serving Camp Chaffee and Camp Van Buren, which was suspended below the Fort Smith-Van Buren bridge deck, was swept away when water rose to above the deck. An emergency line was laid across the river by the 125th Engineers from Camp Chaffee, the line being laid on a pontoon bridge 1,065 ft. long.

Heavy rains fell in the White River valley, to the north of the Arkansas, but flood flows from the two streams are not expected to have any serious effect on the Mississippi. The partly completed Norfolk Dam on a tributary of the White was flooded, water pouring over the lower blocks of the concrete structure but doing little damage.

Highways and railways were flooded at many points and some bridges and embankments were lost.

Eleven inch rainfall

The Weather Bureau reports that 10.62 in. of rain fell at McAlester, Okla., in the three-day period May 9-11, the maximum being 7.02 in. on May 10. At Fort Smith in the same period, 11.01 in. fell.

Indications are that the flooded Arkansas river has cut a new channel on the Fort Smith side of the Van Buren-Fort Smith bridge, according to State Highway Director W. W. Mitchell. It will be impossible to determine the stream's new course until it returns to normal. "The water there is so deep and swift that we can't get in there for soundings," Mr. Mitchell said, "but every indication points to a change in the channel on the Fort Smith side of the bridge."

Floods in other regions

Rivers in central Indiana were over their banks putting many roads and bridges temporarily out of service. In Michigan the Clinton River reached its highest record in 40 years driving many people in Mt. Clemens and Gratiot fr their homes. Selfridge Field at Detr also was flooded for a short time.

Unusual rains, following an extreme wet spring season, caused extensi flooding in southern Ontario, from King ton to Galt, resulting in considerab damage and the loss of at least two live Damage has been mainly confined buildings in city areas, but a section Ontario's new dual lane "Queen Eliz beth" highway has been closed, follow ing the washout of a portion of an em bankment east of Jordan, midway be tween Hamilton and Niagara Falls.

The "big inch" pipeline from Texas t Eastern Seaboard was reported broke at the crossing of the Arkansas River Exact location of the break and exten of the damage could not be ascertaine immediately. First indication of diff culty came from lowering of pressure a pump stations.

Also reported is a break in the Illinoi Pipeline Company's 8-inch line nea Bluffton, Indiana. The break on the Wabash River was repaired after only a few hours.

Press Assn.

Axis war prisoners do emergency flood control work

Army engineers disclose that Axis prisoners of war have been used for emergency flood control work along the Mississippi River in the St. Genevieve, Mo., levee district.

The prisoners, working on a voluntary basis, sandbagged fifteen crevasses in the levee, saving 1,000 acres of rich farm land from imminent inundation. Each man received 80 cents for an 8-hour day in addition to his regular allowance, as a prisoner, of a sum equivalent to his army pay. Regular prisoners uniforms were worn along with special rubber boots issued for the occasion. The "P.W." for "prisoner of war" appeared on the back of each jacket.

Authority to use prisoners of war as an emergency measure was obtained from the Seventh Service Command at Omaha by Col. Lawrence B. Feagin, St. Louis Army district engineer.

War housing tapers off but postwar need may be a million units annually

President asks for $400,000,000 for publicly-financed work as compared with $600,000,000 last year. Some subsidizing is probable

apering off of the war housing job indicated last week when the Pres- t asked Congress to provide $400,- 000 for publicly-financed housing ing the coming fiscal year. This pares with $600,000,000 appropriated the purpose in the current year, and difference is actually greater be- se the National Housing Agency en- d fiscal 1943 with a much larger ryover of uncompleted work than it l have on hand next July.

he drop in housing reflects, with a months lag, the drop in construc- n of new industrial facilities that an last fall. Although some policy blems still face NHA, war housing struction is now pretty much in the ove, is a matter of following along well-established lines. Remaining estions involve such matters as ad- tment for contract cut-backs, adjust- nt of the programs to the shift from gle men to family men and women in r plant employment, the need for re careful estimates of requirements housing in particular localities as end of the program is reached, and like. But by and large, the con- versies and policy reversals which al- st wrecked the war housing program its beginnings are over.

Consequently, NHA officials now feel er to devote some of their thinking the postwar problems of housing. As- tant administrator Coleman Woodbury now giving about half his time to stwar work and is accumulating a all staff.

No slum clearance

Studies are still very preliminary, but HA people have satisfied themselves t immediate postwar need for housing will run to about a million units a year. This figure does not allow for any slum-clearance or other replacement of sub-standard housing. It is based on the needs of new families, the working off of the backlog of need resulting from the cessation of building during the war, and the replacement of houses which becomes uninhabitable. If the government wished to go in for a slum clearance program in addition, anything up to another million might be added, with an optimum program probably falling in the neighborhood of three quarters of a million.

How much of the first million would call for some form of subsidy would depend on the amount and distribution of national income after the war. Under present income conditions, the whole million probably could be built without any subsidy. More likely, the lower end of the million would have to be subsidized.

Any attempt to estimate the geographical distribution of postwar housing is considered rather fruitless under present conditions. Similiarly, it is not thought that much can be accomplished now by advance studies of an engineering or architectural nature. Because of material shortages, the war job has been comparatively barren of technical innovation except in the way of material conservation and site pre-fabrication. Moreover, NHA is technically pretty conservative, and although it is keeping in touch with industrial studies of prefabrication and packaged housing, it is not really much interested.

Subsidies and insured loans

The same basic governmental mechanisms that were in use before the war, it is thought, will be adequate to the postwar job—subsidized housing, through Federal Public Housing Authority and local housing authorities, for the lowest income groups; insured loans, through FHA, for the upper brackets.

Some change in the subsidy procedure is favored. The pre-war policy of basing subsidy on a percentage of the construction cost put a premium on expensive construction to reduce maintenance expense and tied the slum-clearance program to projects designed to last for sixty years. If subsidy were based on a percentage, instead of on the economic rent which would be charged if the projects were to be self-liquidating, it would give more flexibility. Thus, the annual cost might prove to be less if a house were built to last 25 years, if construction economies outweighed the quicker amortization and higher maintenance costs.

For the promotion of housing which is not directly subsidized, several new possibilities are being explored—"equity insurance" and land assemblage. Equity insurance is a scheme which was being talked up just before the war. It would be an effort to encourage large investors, insurance companies and the like, to put money into housing by guaranteeing some small return, 1 or 2 percent on the investment.

Use of federal powers to assemble substantial tracts of land for private builders, it is thought, might encourage utilization of the economies of large scale rental housing. Moreover, if the scheme were coupled with some such plan for writing off inflated land values as is incorporated in the Thomas urban rehabilitation bill now before Congress, erection of new private housing in blighted city areas could be promoted.

• • •

New cut planned in war plant building

The War Production Board last week tightened the screw another turn in its effort to cut down the amount of material and manpower being devoted to construction work this year. It has set up a stiffer procedure for approving future projects for building manufacturing plants and will once more reexamine existing projects. Hope is to cut in half the five billions or so of work still to be done on projects now under way or scheduled.

The stricter policy is limited to construction of manufacturing plants. Construction of facilities for production of raw material—synthetic rubber, steel, etc., is not restricted. In fact it may soon be increased. Public works and other non-manufacturing projects apparently continue on present procedures.

WPB has been engaged for nearly a year in the effort to cut down on the building of new facilities, believing that scheduled projects were outrunning raw materials capacity. A series of increasingly stringent restrictions have been imposed, but none of them has cut as deep as WPB would have liked. The constant impulse of the Army, Navy, and Maritime Commission is to increase facilities, and WPB can't keep them under control. Thus, last year it was hoped to cut the 1943 program by some three billions, but cuts actually made have amounted to less than half of that sum.

To carry out its new policy, WPB is setting up a new Facilities Review Committee to pass upon all present and future facility projects. The new committee is stronger than its predecessor, the Facilities Clearance Board, in several respects. For one thing, the previous power of the Army and Navy Munitions Board to approve smaller projects is wiped out. It is believed that some projects had been split up to get them through ANMB and to by-pass WPB. For another thing, the new committee will be composed of high-ranking officials of all the major federal procurement agencies, and will thus carry more weight. Finally, the new committee has power actually to re-allocate procurement contracts. Thus when some agency insists on a new plant, the committee can give it instead some plant which is not now fully utilized.

Building officials plan to set higher standards of competence

Building Officials Conference of America hopes to gain better public recognition of its work by setting standard qualifications for supervision of safety and health precautions.

Failure of the public to recognize the responsibility that is placed on officials charged with protecting public safety, health and general welfare has resulted in the establishment by the Building Officials Conference of America of a committee to set up recommended standard qualifications for building officials as to character, competency, powers and duties. This action was taken at the 28th annual meeting of the conference, which was held in Richmond, Va., May 10-13. Despite government restrictions on travel, fully 50 percent of the accredited members were present, representing 61 municipalities, 21 states and the province of Ontario.

The opening paper, "Controlling Daily Activities of Building Inspectors," by Commissioner Herbert L. Seaman of Pittsburgh, Pennsylvania, served as the keynote speech of the convention. Much stress was laid on the important position which the building official occupies in the social structure and the failure of the general public to give proper recognition to his services in the interest of public safety, public health and general welfare. The facilities accorded him for the administration of laws regulating the construction, use and occupancy of buildings are generally limited, and yet, when catastrophies occur, he comes prominently into the limelight. This thought was repeatedly emphasized in at least eight of the seventeen formal papers, and in one of the general discussions. As a result, the committee to set standard qualifications was authorized.

Building codes

Papers relating to building codes and public safety included one by George N. Thompson of the National Bureau of Standards on advantages and disadvantages of state building codes; an intensely practical paper by Capt. Walter F. Stiles of the Connecticut State Police on Safety in Motion Picture Theatres in which the responsibilities of the building official and of the fire marshal with respect to the public safety were clearly distinguished; an important discussion by T. J. Whelan, of the Travelers Insurance Co. on safety during construction, a subject that is too frequently omitted from building codes; and an address by E. M. Hastings, chairman of the Richmond City Planning Commission, on "The Building Official and the Zoning Board of Appeals." The city council of Richmond had just enacted a new zoning ordinance.

In his address, George N. Thompson of the National Bureau of Standards pointed out that there are nearly 2,000 local building codes that regulate the manner in which building construction may be carried out in this country. Since these codes have been adopted at different times, in many cases using different sources of information, they naturally reflect a variety of ideas as to what is proper for safeguarding occupants of buildings and the general public.

Statewide requirements

A few codes are in existence that establish minimum requirements on a statewide basis. In such cases muncipalities, if they so desire, may adopt additional or more stringent provisions. The more general adoption of statewide requirements would seem to offer certain advantages, including greater uniformity in the rules bearing upon designers and manufacturers of building materials, centralized approval of new materials and methods of construction, and more prompt adoption of improvements suggested by technical research. The fact that the use of such codes is not widespread, indicates that objections, not immediately apparent, may exist.

Since a great deal of attention is being devoted to the development of improved technical requirements, Mr. Thompson thinks it is logical that the means by which these improvements find a way into legal applications should receive at least an equal amount of thought.

Walker S. Lee, superintendent of buildings of Rochester, New York, was re-elected president. Andrew C. Leake, building inspector of Kalamazoo, and Herbert L. Seaman, superintendent of the bureau of building inspection of Pittsburgh, were elected vice-presidents.

• • •

Steel Institute adds four to its advisory board

At a recent meeting of the board of directors of the American Institute of Steel Construction, the following were added to the technical advisory board: H. H. Allen, consulting engineer, the J. E. Greiner Co., Baltimore, Md.; F. A. Burdett, consulting engineer, New York, N. Y.; C. A. Trexel, Captain (CEC), director, Planning and Design Division, Bureau of Yards and Docks, Navy Department, Washington, D. C., and H. B. Zackrison, principal engineer, Office of the Chief of Engineers, War Departmen Washington, D. C.

Ten years ago the institute establishe a board, consisting of engineers of nationally recognized authority, to act i an advisory capacity. The board assis the institute in its work of coordinatio of architectural and engineering technic requirements for structural steel wit industrial standards and economy of de sign. Under the guidance of the advisor board these standards are kept abreas of the new developments in structura engineering and fabricating technique.

• • •

Welded steel oil barges ordered by the ODT

Because wooden barges cannot carr light oils, the Office of Defense Transportation reports that construction o 195 of the scheduled 500 wooden barge has been cancelled and will be balance by a fleet of 168 all-steel welded barge capable of handling both light and heavy oils. Actually, the steel barge will more than balance the wooden ones as they will carry 1,600,000 barrel against 1,170,000 which would have been carried by the wooden barges.

The new barges, many of which are expected to be ready by late October will operate on the Mississippi and Ohio Rivers to increase the transportation o oil to the Eastern seaboard.

• • •

Arizona wants its share of Colorado River water

A tentative contract for "all of the water Arizona is entitled to receive under the Colorado River compact, the Boulder canyon project act and the Boulder canyon adjustment act" was drafted May 5, by the committee of 14 experts representing the seven basin states. The committee then adjourned to reconvene in Denver on May 26, for revision and approval of the contract before it is submitted to Interior Secretary Harold L. Ickes.

The contract would put into effect principles which Arizonans long have fought to uphold, and make possible a broad postwar program of development in that state.

As tentatively drawn, the contract provides for: (1) delivery to Arizona of 2,800,000 acre-ft. of water from the main stream of the Colorado River; (2 delivery to Arizona of half the surplus waters of the river, subject to the possibility that at some time Nevada may be able to use 1/25 of the surplus water; and (3) freedom of Arizona to divert her share of the water above Boulder Dam, if in the future legislation and projects built upstream would make that possible.

erman storage dams lasted by R.A.F.

(Continued from page 51)

hrough the gap widened the opening. eturning crews said that they saw reach 100 yd. long in the Moehne and that a wall of water 30-ft. high hed down the valley. The same crews rted that they saw the power station t away and the river spread itself the lowlands.

econnaissance photographs taken in ight following the attack on Eder showed the river in full flood and uncontrollable openings in the dam. he dams are about 45 miles apart, on erent watersheds, and separated by a . wooded region. The Sorpe Dam a Ruhr tributary also was attacked information on the damage is not ilable. The Moehne and Sorpe dams trolled about 70 percent of the flow he Ruhr River.

• • •

City planners honor E. M. Bassett

dward M. Bassett was hailed as the ther of zoning and the best-known hority on this subject in America" on y 14 when leaders in the architectural community planning field presented with a medal of honor for city plang. This occurred at a luncheon meet- in New York given jointly by the w York and Brooklyn chapters of the erican Institute of Architects, the tropolitan Section of the American Soy of Civil Engineers, and the New rk chapter of the American Society Landscape Architects.

he medal is bestowed to recognize honor distinguished contributions to planning of the City of New York.

Mr. Bassett's work for the original n of New York led to legislation in 26 and 1927 that extended to every nicipality in the State the right to ablish an official planning commission.

• • •

xtensive war housing at Portland, Ore.

Harry Freeman, executive director of e Housing Authority of Portland, Ore., s announced that 9,574 dwelling units the Authority's program of 17,916 e been completed, and that 8,908 occupied. Vacant units ready for upancy number 606. In about a nth 2,232 additional units will be mpleted, and in two months, the re- ining 3,198 in Vanport City will be dy for occupancy. This development is said to be the most outstanding of its kind on the Pacific Coast.

JOBS OF THE WEEK

STORAGE FACILITIES, Washington
U. S. Engineers, Seattle, Wash., awarded contract for storage facilities to exceed $1,000,000 in cost. Work, which is at air force installation, Spokane County, has been awarded to Sound Construction & Engineering Co., and Ford J. Twaits Co., Seattle.

RECONSTRUCTING HIGHWAYS, Halifax, N. S.
Province of Nova Scotia, Halifax, will reconstruct secondary highways by day labor. Estimated cost is $1,275,000.

BUILDINGS, Renous, N. B.
Dominion Government, Ottawa, Ont., Canada, awarded contract for buildings and magazine stores to Diamond Construction Co., Ltd., Fredericton, N. B. Estimated cost is $1,400,000.

HOUSING, Provo, Utah
Provo Housing Corp., Provo, will construct 341 dwelling units, northeast of Provo. Taylor & Wheeler, Fresno, Calif., will build the project, which was designed by Frank W. Green, of Los Angeles. The cost will be $2,000,000. Work will be privately financed and FHA insured.

ARMED GUARD SCHOOL, Camp Bradford, Va.
Ross Engineering Co., Washington, D. C., has been awarded the contract for construction of armed guard school, Princess Anne County by Bureau of Yards & Docks, Navy Dept., Washington, D. C. The project will cost $2,837,337.

HOUSING, Georgia
Public Building Authority, Atlanta, Ga., awarded a contract for housing constructing to J. A. Jones Construction Co., Charlotte, N. C. The estimated cost is $2,300,000.

HOUSING, San Bernardino, Calif.
McCray-Joosten Building Co., San Bernardino, Calif., is constructing dwellings by its own forces. Estimated cost is $1,000,000. Charles O. Matcham, Los Angeles, is the architect.

HOUSING, Utah, Washington, Idaho and Oregon
Nordin Construction Co., Los Angeles, Calif., has been awarded a contract for constructing housing by American Land Co. The estimated cost will exceed $1,000,000. Project includes 400 dwellings at Orem and 250 at Ogden, Utah; 400 dwellings at Spokane, Wash.; 100 at Pocatello, Idaho, and 1,200 at Portland, Ore.

WATER PIPE, San Juan, P. R.
City of San Juan awarded a contract for 70,000 ft. 36 and 42 in. prestressed pipe, to Lock Joint Pipe Co., Ampere, N. J. The estimated cost is $900,000. Malcolm Pirnie, New York, N. Y., is the engineer.

HOUSES, Arvida, Que.
J. L. E. Price & Co., Ltd., Montreal, Que., awarded a contract for two hundred houses to be built by the Aluminum Company of Canada, Ltd., Montreal, Que. The estimated cost is $1,073,700.

IMPROVEMENTS, Arizona
United Concrete Pipe Corp., Los Angeles and Arizona Sand & Rock Co., Phoenix, Ariz., were lowest bidders for improvements in Maricopa County, when U. S. Engineers, Los Angeles, Calif., opened bids. The cost of the project will exceed $500,000.

HOUSING, Mississippi
Public Housing Authority, Atlanta, awarded a contract for housing to A. Farnell Blair, Decatur, Ga The estimated cost is $606,798. Landry & Matthes, Hattiesburg, Miss., are the architects.

HOUSING, Maryland
Public Housing Authority, Washington, D. C., received bids for constructing housing. Samuel M. Pistorio, Baltimore, Md., was low on Proposal 1 at $798,594; and Proposal 1A at $824,604; Tovel Constr. Co., Baltimore, Md., Proposal 2, $676,900, Proposal 3, $661,400; National Structures Corp., New York, N. Y., Proposal 2A, $787,476.

HOUSING, Texas
Knutson Construction Co., Houston, Tex., was the lowest bidder for housing project, San Felipe Courts, at $1,053,711. Housing Authority of Houston opened bids for the Public Housing Authority.

Note—Additional bidding and contract news on many projects large and small appear in the Construction News section beginning on page 151.

Construction Communiques

Engineering News From the Battle Fronts

New Guinea—Mosquito eradication to control malaria in the New Guinea area has been advanced by joint action of the U. S. Army air forces and the Australian Army, according to an announcement by the War Department. The expanded program was put into effect after medical reports showed that more Allied troops were admitted to hospitalization for malaria than for battle wounds in the area.

First move was to strike the mosquito at his weakest point—in the incubation stage—before the wings sprout and the proboscis is hardened to skin-puncturing toughness. This called for hours of backbreaking draining, ditch-digging, oiling of swampy sloughs where the pests were breeding, disposing of receptacles capable of storing stagnant water, oiling slit trenches, and scores of other such jobs.

Some troops could not be spared from the front lines for this work, the authorities gave the army doctors first priority on native labor for the malaria control program. There are now 1,400 New Guinea natives working on the project.

Allied fighting forces also are being made malaria-conscious by other means. Educational motion pictures, films, posters, lectures and insistence that all servicemen from private to general take preventive measures prescribed by army regulations are some of the means used.

Lt. Col. E. Ford, malariaologist of the Southwest Pacific, New Guinea Forces of Australia, is in charge of the program.

On all Fronts—The Army has developed portable pipelines to carry gasoline supplies to motorized units in the field, the Office of War Information reports in a review showing the difference between the petroleum needs of this and the first World War.

OWI said the new pipeline comes in self-contained half-mile units, each complete with a centrifugal pump driven by a 20-hp. gasoline engine. The apparatus can be moved by cargo truck and used independently of any other unit.

These self-contained sections, alone or in combination, are said to be able to deliver gasoline through swamps and forests or over mountains at a rate of approximately 200 gpm. The pipe also can be used to assist or even replace floating gasoline tanks for ship-to-shore operations.

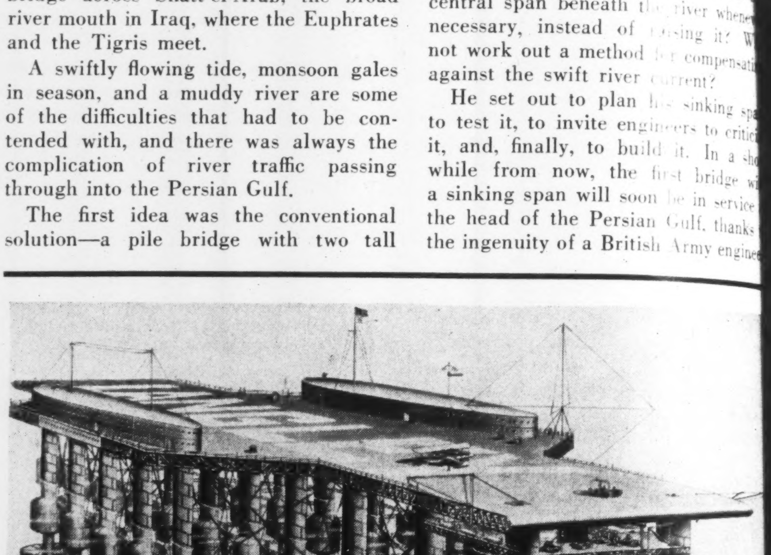
Middle East—A bridge, the central span of which sinks below the water, instead of lifting—an entirely original conception in the art of bridge building—is one of the many new inventions to which the necessities of war have given birth in the Middle East.

The idea occurred to Brig. Gen. Gifford Hull, engineer in charge, when faced with the necessity of building a bridge across Shatt-el-Arab, the broad river mouth in Iraq, where the Euphrates and the Tigris meet.

A swiftly flowing tide, monsoon gales in season, and a muddy river are some of the difficulties that had to be contended with, and there was always the complication of river traffic passing through into the Persian Gulf.

The first idea was the conventional solution—a pile bridge with two tall towers in the center, and a central 90 span to be raised when necessary for passage of river traffic. Work got un way with surprising speed. Timber fr India driven into the river bed shaped into 40-ft. piles and the two e of the bridge grew quickly toward center of the river. But the thought t the high towers would be exposed to strain of the incalculable monsoon bo ered General Hull. Why not sink central span beneath the river whenev necessary, instead of raising it? W not work out a method for compensati against the swift river current?

He set out to plan his sinking spa to test it, to invite engineers to critic it, and, finally, to build it. In a sho while from now, the first bridge wi a sinking span will soon be in service the head of the Persian Gulf, thanks the ingenuity of a British Army engine



Floating airport idea revived for postwar construction

Full-page advertisements in metropolitan dailies last week announced that Pennsylvania-Central Airlines had filed an application with the Civil Aeronautics Board for a "seadrome" route across the Atlantic Ocean to Europe, on which three floating airports would be used at 800-mile intervals. The "seadromes" are the design of Edward R. Armstrong, which was described in Engineering News-Record of May 16, 1929, p. 794, an illustration from which appears above.

Proposed by PCA as a postwar undertaking, the floating airports are sponsored and would be constructed by the Sun Shipbuilding and Dry Dock Co. It is reported that the United States Steel Corp., the Worth Steel Co., the Belmont Iron Works and the John A. Roebling Sons Co. are associated in the project.

As shown in the illustration, the landing deck of the floating steel island is supported by upright columns, each of which contains a buoyancy chamber. The base disks on eac column are to be filled with iron ore ballast t lend stability. Diagonal rod bracing is use between the various columns, while trusse struts join the columns at the disks, at the to of the buoyancy chambers and at the dec level.

The landing surface would be about 70 f above the water surface, and the structure ha an overall draft of 160 ft. Anchorage cable will be used to fix the position of the "sea-drome", but it can be turned so that plane will be able to land into the wind at all times The length and width of the present propose airports were not revealed.

Original plans for the "seadrome" wer conceived in 1922 by Mr. Armstrong, a civi engineer of Philadelphia. In 1929 designs ha progressed to the point where construction o an experimental structure was to have bee built, but this did not materialize.

OBITUARY

n Hole, 69, engineer with the s Department, Toronto, Ont., died t city on April 30. Mr. Hole had ised in Toronto as consulting engi- and architect. From 1912 to 1918 as associated with the Toronto or Commission.

ward Rich, 64, engineer and street issioner of Pelham, N. Y., died 8. Mr. Rich was graduated from lin College and the Massachusetts tute of Technology. He had been e employ of Pelham for the last ty years.

seph R. Lasbrooke, 59, died re- ly at San Fernando, Calif. He was inent in southern California civil neering circles, and for the last two s had been consulting engineer in nsion work at some of the Los An- s aircraft plants.

illiam MacCanna Laverty, 76, re- president of Brann and Stuart Co., neering and contracting firm, died Merion, Pa., May 13. Mr. Laverty been a civil engineer in the engineer- department of the Pennsylvania Rail- l. and was a member of the Engi- s' Club of Philadelphia.

ristofer Oustad, 86, who died re- ly in Minneapolis, was a native of way and was educated at the Trond- n Technical High School. Shortly af- coming to this country he entered employ of the City of Minneapolis served the city continuously for 46 rs. As engineer of bridge design, he gned several large reinforced con- e bridges in Minneapolis, notably Third Ave. Bridge and the Franklin e. Bridge. The latter, at the time of conception, was said to have had longest single span reinforced con- te arch in the world—450 ft. in gth.

C. E. Inman, 78, for 34 years city ter superintendent of Warren, Ohio, d an outstanding waterworks expert, d there May 10.

Angus MacArthur, 54, vice-president d director of Koppers Co., Pittsburgh, P., and general manager of its gas and e division, with headquarters in New rk, died May 9 at Old Greenwich, nn. Mr. MacArthur had been asso- ted with Koppers since 1920 when joined the organization as operating gineer. He was promoted to his latest sition in 1933, and was transferred m Pittsburgh to New York in 1939.

John W. Towle, 70, who was resident engineer in charge of the Hog Island Shipyard at Philadelphia, Pa., in the First World War, died at Omaha, Neb., on April 30. Mr. Towle was graduated from Cornell University as an engineer in 1894, and he was the first surveyor of Richardson County, Neb.

John William Henderson, 43, died April 25 at Akron, Ohio. He had been an operating engineer and had been working on construction projects at the Ravenna Arsenal.

Harold J. Horan, 50, senior highway engineer, Chicago office of the U. S. Public Roads Administration, died May 12. Mr. Horan was a graduate of Michigan State College.

Normandie is expected to be afloat by fall

Salvage operations in New York on the burned and capsized Lafayette, the former French Normandie, will be completed and the ship floated by the coming fall, Admr. E. L. Cochrane told a House Appropriations subcommittee.

News of the Week
Continued on p. 100

Admr. Cochrane, who is chief of the Bureau of Ships, estimated that another nine months would then be required to remodel as a troop transport. Cost of salvage job is estimated at $4,000,000, with an additional $15,000,000 or more for the remodeling.

CONTRACTS AND CAPITAL

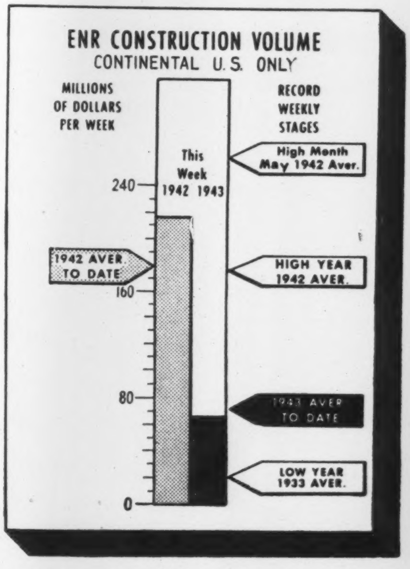
Civil engineering construction volume for the week in continental U. S. totals $63,929,000. This volume, not including the construction by military combat engineers, American contracts outside the country, and shipbuilding, is 30 percent lower than in the preceding week, and 71 percent below the total for the corresponding 1942 week.

Private construction tops last week by 247 percent, and is 10 percent higher than in the week last year. Public construction declines 39 percent from a week ago, and is 74 percent lower than a year ago, as both state and municipal work and federal volume are down.

The current week's construction brings 1943 volume to $1,445,294,000, an average of $72,265,000 for each of the twenty weeks of the year. On the weekly average basis, 1943 volume is 60 percent below the $3,773,129,000 reported for the twenty-one weeks of 1942. Private construction, $146,112,000, is 48 percent lower than last year, and public work, $1,299,182,000, is down 61 percent when adjusted for the difference in the number of weeks.

In the classified construction groups, gains over a week ago are in sewerage, and industrial, commercial and public buildings. Commercial building is the only class of work to gain over a year ago.

New capital for construction purposes for the week totals $463,000, and is made up entirely of state and municipal bond sales. The week's total brings twenty-week 1943 new financing to $489,749,000, a total that compares with $6,811,776,000 reported for the twenty-one weeks in the preceding year.



Continental U. S. only—construction by military combat engineers, American contracts outside U. S., and shipbuilding not included.

CONTRACTS

Continental U. S. Only
(Thousands of dollars)

	Week Ending		
	1942 May 21	1943 May 13	1943 May 20
Federal	$195,721	$80,641	$49,558
State & Municipal	11,487	7,435	4,162
Total public ..	$207,208	$88,076	$53,720
Total private..	9,305	2,943	10,209
TOTAL	$216,513	$91,019	$63,929

Cumulative
1943.......(20 weeks)......$1,445,294
1942.......(21 weeks)......$3,773,129

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative	
	1942 21 weeks	1943 20 weeks
NON-FEDERAL ..	$272,821	$89,399
Corp Securities.	87,366	2,821
State & Mun....	138,042	74,945
R.F.C. loans....	47,413	8,500
FPHA loans....	....	3,133
FEDERAL	$6,538,955	$400,350
TOTAL CAPITAL	$6,811,776	$489,749

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost..	May '43..	289.87	139.34
Building Cost......	May '43..	227.64	123.06
Volume	Apr. '43..	225	99

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

A Record of the Past

Sir: In 1925 you published an article of mine entitled "Determining the Energy Loss in the Hydraulic Jump", (*ENR*, June 4, 1925, p. 928) wherein was developed the formula for losses

$$i = \frac{(y_2 - y_1)^3}{4y_2\, y_1}$$

where i = head loss in the jump
y_1 = initial depth at begining of jump
y_2 = depth at end of the jump.

The writer had never before seen an expression for these losses, combining the principles of conservation of energy and of momentum, and assumed that he had stumbled onto something new. However, as has been so often said, "There is nothing new under the sun". Recently, the writer learned that this formula was developed by a Prof. M. Breese, and presented in a course of lectures on applied mechanics at the School of Bridges and Highways in Paris in 1860.

The writer hereby wishes publicly to acknowledge Prof. Bresse's priority in this formula as far as he is concerned.

J. C. Stevens
Stevens & Koon, Consulting Engineers
Portland, Ore.

No Creosote Shortage

Sir: On page 480 of *ENR*, Apr. 8, 1943, is an article, "Pulled Piles Reveal Effectiveness of Asphalt-Treated Wrapping." The first sentence in this article, "Wartime shortages of creosote for treating piles has focused attention on other means of protecting untreated piling from marine borers," contains a gross inaccuracy. There is no wartime shortage of coal-tar creosote. It is being manufactured and distributed to all treating plants in ample quantities for all necessary requirements. The facts are correctly stated on page 757 of your Dec. 3, 1942, issue, as follows: "Rapidly increasing distillation of tars for production of chemicals is expected to result in so much by-product output of creosotes as to eliminate soon any tightness in the supply for wood treatment." Production since then has exceeded expectations.

This being the case, there is no need to resort to experimental measures to protect timber piles from marine borers. Encouragement of such practice promotes neither economy nor conservation of material, since early failure of a considerable percentage of these untreated piles is inevitable, and replacement will become necessary at a time when procurement of material will in all probability be even more difficult than at present. On the other hand, effective pressure creosote treatment would insure a long serviceable life for the piles.

P. R. Hicks
Secretary-Manager
American Wood-Preservers' Association
Chicago, Ill.

Thoughts on Inspection

Sir: The term "professional engineer" as the writer understands it, is intended to be all inclusive of those who by training and practice follow engineering in some branch of that profession. Therefore, the trained inspector of any phase of engineering work is practicing "professional engineering." There have from time to time, been short articles published, touching mostly on some one phase of inspection, but none which the writer recalls as having read, which have attempted to cover the field as a professional activity.

The inspector if he is to function properly, must at all times keep an open mind, be unprejudiced, yet at the same time recognize that he is employed to serve the best interests of those employing him, though always weighing the pros and cons wherever there may be anything controversial, and bring to the attention of his employer anything that in his judgment may appear unfair to the owner, the contractor, the furnisher of materials, and/or the producer.

In an article published some months ago in *Engineering News-Record* the question was asked whether an inspector could function as an umpire. The answer to that of course is yes if the inspector is properly equipped by experience, training and temperament; but if he is lacking in any one of these three essentials, No!

To be an inspector, able to judge of his duties so that the answer may be "yes", it does not necessarily follow that the inspector must have graduated from an engineering school, but he must be intelligent, understand the principals and theory of engineering, have had sufficient education to apply these principals and theory, and be able to calculate the probable service stresses of the particular structure, construction, or materials he is inspecting. He must also have had sufficient practical experience to recognize the importance of what he is in charge of and must be temperamentally fitted to act in a manner that will be fair to all interests.

Under conditions as they exist today, and taking into consideration the importance of real inspection service, the average inspector is not (speaking in general terms) sufficiently recognized either as to the importance of his job nor as to his compensation.

The reasons for this are:

First: The owner, generally, is not conscious of the importance and protection of qualified inspection, and is prone to feel that it should be included in engineering fees as at present established, instead of recognizing that engineering fees are primarily for designs and specifications, and that if supervision is included, an additional fee should be added.

Second: The engineer for the owner often does not, in making the arrangement for his services, bring to the owner's attention the fact that inspection, both in the field and at producing points, is desirable and usually essential, and good insurance; and in recent years, in placing the burden of the cost for inspection service, it has either been on the contractor or producer or both, with the result that inspection has been cheapened and placed on a competitive rather than a selective basis with all of the attendant evils of commercial competition, and improperly equipped inspectors.

Who should bear the cost of inspection service? There may be any one of several answers:

(1) If a large and adequately financed organization, either public

r private, the answer should be immediately, the owner.

(2) If a small organization or one ubject to regulations which may in ome form make a selective choice ard, it would be possible for the wner, contractor, and materials producer jointly to bear the cost, the wner to select the inspector and pay is part, and deduct their part of he cost from monies due the other two.

(3) If the situation is such that he owner can pay no part of the cost as in (2), then the owner should select the inspectors from a list of names nominated by the contractor and producer, and deduct the costs and pay inspectors from credits of the other two.

W. R. Conrad
Engineer and Consultant.
Burlington, N. J.

More on Floor Joists

Sir: In your March 25, 1943 issue, p. 447, T. B. Rights, commenting on the article "Truss-Braces on Joists Steady 22-ft. Spans" (appearing in *ENR* Dec. 3, 1942, p. 797) cautioned young engineers to beware of this idea since it was based on fallacy, but his comments show lack of knowledge of wood.

First: A 2x16-in. joist of Douglas Fir (coast region) on 22-ft. span at 16-in. c. to c. spacing is good for 64 lb. per sq.ft. in bending on assumed 1,200 psi. grade, or more than 71 sq.ft. at deflection of 1/360, as for plastered ceiling. Thus, if normal cross-bridging is installed at 8-ft. intervals or less, two lines for a 22-ft. span, no strengthening is considered necessary.

Second: Lumber never does reach zero percent as Mr. Rights indicates, but reaches a moisture equilibrium approximating those shown in Table 41 in "Wood Handbook" prepared by Forest Products Laboratory. Thus the shrinkage he indicates will not occur. Also, as shown in Table 8 of same authority the modulus of elasticity increases with dryness, thereby improving stiffness.

Third: Mr. Rights' concern about overstressing the lower part of a wood joist is unnecessary since wood is considerably stronger in tension than in compression (see Wood Handbook p. 105).

It is contended, then, that where deflection governs a design, wood floor joists may satisfactorily be stiffened by a method somewhat as that shown in the Dec. 3, 1942 issue of *ENR*, although a method proven more practical in use is the placing of 1x4-in. continuous strips arched to joist depth each side of the joist, when headroom limitation or inability to secure deeper or heavier joists prevails.

J. E. Mackie
Civil Engineer,
San Francisco, Calif.

Staggered Rail Joints

Sir: I have been interested in reading the letter of Leonard C. Jordan in the issue of Mar. 25, p. 41, regarding staggered rail joints.

Mr. Jordan ascribes the use of staggered joints to what is sometimes called "the inertia of precedent," or as he says, "That's the way it's always done, so that's the way to do it."

This conception of the attitude of railroad engineers is fully as faulty as his statement that rail joints have always been staggered. I shall not attempt a discussion of the mechanics involved; they are quite involved, but anyone interested will find an excellent discussion in "Vibration of Rail and Road Vehicles" by B. S. Cain of the General Electric Co., especially beginning on p. 214.

I do wish to point out to non-railroad men who may not know, that originally it was the practice to place the joints opposite each other. Some light traffic and slow speed branch lines are still so constructed. Where speeds are low and track maintenance limited to what is essential for safety, such construction does avoid the tendency for the car to roll synchronously with the alternating joints, when the latter are low and at certain critical speeds. However, with square joints, the rolling is replaced by (what is at least as objectionable) a tendency for the cars to "hop, skip and jump" along the track at the critical speed. The critical speeds depend on many factors such as rail length, wheel base, truck spacing, type of car springs, design of truck and of car, etc., and, therefore, vary with variations in any of these factors.

It is thus because of experience over long years with both types of construction that joints are staggered on well maintained modern track. The wisdom of this practice is not only proved by the actual results, but by the theoretical analyses such as the one cited.

W. J. Burton
Missouri Pacific Railroad Co.
Assistant to Chief Engineer.
St. Louis, Mo.

Building Costs

Sir—The thoroughness and fairness of Arthur F. Comstock's article on "Cost Comparison of Wood, Steel and Concrete Warehouses" (*ENR*, April 22, 1943, p. 626) resulting in an extremely valuable contribution to the engineering profession, must be highly commended.

The author implies the possibility of doubts regarding the correctness of his statements arising in the minds of the proponents of the various types of structures compared. We, the proponents of the monolithic concrete alternate, however, know from facts and experience that the author's conclusions are fully unbiased. Of course, we could argue about slight differences in certain cost items if other than conditions as set forth in the article exist, but the author specifically states, rightly, that any cost set-up "is applicable only to a particular place and at a particular time." The author's conclusion that the cost of the various types of warehouses is practically the same is supported by the fact that at certain locations competitive biddings showed the concrete warehouse to be the cheapest in spite of the fact that at that time no advantage of higher allowable unit stresses in reinforcing steel could be taken.

Digressing from the idea of comparing the represented type sof structures merely from their utility value as temporary warehouses, it should be noted that the steel building has 45 percent more and the wood building almost three times as many bays and interior columns. Further the concrete building will offer the advantages inherent to all concrete structures, namely, permanency, fire and sabotage resisting qualities, low maintenance and insurance rates, etc. However, it is appreciated that this article is primarily a comparison of construction costs, and consideration of these details would probably not be in keeping with this otherwise excellent article.

John E. Kalinka
Vice President
Roberts and Schaefer Co., Chicago

EDITORIALS

VOLUME 130 NUMBER 20

May 20, 1943

Plywood Finds Favor

WHEN THE ARMY wanted 170 barracks in a great hurry last year for temporary, West Coast service, a few reliable contractors were asked to bid "over night." One San Francisco contractor bid on the specified paper-lath finish, and also put in an alternate bid on buildings with plywood walls, which he said would last longer, look better, cost **$100** per building less and could be built quicker. He got the job. He used 1,500,000 sq.ft. of plywood, and finished in nine working days instead of the fifteen that the rush Army schedule allowed for the other type. The event attracted the attention of high officials, and plywood advanced on the priority list into the AA1 class. Here is another instance of war speeding appreciation of a product well suited to needs previously served by something else. And because plywood has found favor so widely, it is important that its manufacturer, like the manufacturer of such other engineering materials as steel, concrete, cast iron and aluminum, be understood by engineers. An article in this issue is devoted to the creation of such understanding.

Start Planning at Home

PLENTY OF SOUND ADVICE and suggestions came out of the A.R.B.A. conference in Chicago last week, but none more pertinent than Willard T. Chevalier's warning that effective postwar planning must start at the bottom and spread to the top, instead of originating at the top and filtering down to the bottom. He cautioned those responsible for planning not to wait for Washington or some super board to tell them what to do, but to go ahead and work out their own programs. Postwar construction will be done in the local communities, not in Washington, so the program should originate and be worked out at home. The local agencies know what is needed, what constitutes sound projects, what will prove capital investments instead of make-work projects. Naturally, some part of the postwar program will be huge projects of national scope, such as flood control and waterways, but the bulk will be made up of smaller local projects. Every community, every public agency responsible f construction, should be working on plans right no Furthermore, as Gen. Philip Fleming told th roadbuilders, the time for speculative planning i past; the time for design planning is here.

Postwar Equipment

BOTH contractors and equipment men assured th American Road Builders Association meeting las week that the necessary machinery will be availabl for any postwar construction program. Ham Penn veteran distributor, pointed out that there are no more than 400,000 units of equipment in the hand of public agencies and contractors. However, thi equipment is already one to five years old, and it age at the end of the war is, of course, uncertain Yet with the amount of work in this country i sight for the duration, there is little chance of al of the equipment on hand being worn out. Col E. R. Needles told the roadbuilders that most of the 100,000 machinery units owned by the Corps o Engineers is being overhauled for combat and Alca Highway service, and probably will not be returned to this country. He also declared that within six or eight months the Army would be out of the equipment business, that time being required to finish up the repair work now being done on Army machines in equipment distributors' shops. This work is of first importance, and should be rushed, for just as soon as the Army units are out of the shops the public-owned and contractor equipment should be overhauled. It may be needed for a quick start on postwar construction.

A Check on Niagara Erosion

HISTORY MAY NOT RECORD the fact that it took a world war to compel this country and Canada to carry out a project that was needed to preserve one of the great natural spectacles of the world, but that is substantially the case. For many years it has been known that the Horseshoe Fall at Niagara was receding rapidly under erosive action, and that in measurable time the American Fall would be dry and the Horseshoe Fall would be greatly reduced in size. It has also been known that construction of a low weir across the river above the Horseshoe would check the erosion by spreading the flow out over a wide area. Elaborate model studies were made to determine the best way to redistribute the flow, and commissions reported, but nothing concrete was done because sentimentalists opposed trying to improve on nature, and others saw in the projected weir a scheme of the "power interests" to steal more power from the

In the end as a matter of fact, it was power, preservation of the falls, that forced the issue. weir raises the pool above the falls, thus insing the head on the power plants. Also the over the American Fall has been increased, it is certain that the progressive recession of Horseshoe Fall will be greatly checked in the s to come. Preservation of Niagara is one item can be credited to the asset side of the war.

A—A Notable Record

YEARS AGO the Tennessee Valley Authority set up by the new Roosevelt Administration as nation's first great experiment in coordinated elopment of the natural resources of a complete r system. The extremes of praise and condemion with which the inauguration of that social eriment was met are well known and need not reviewed here. Worth review, however, are the ineering aspects of the experiment as seen from end of its first decade.

rom the start it was obvious that a large amount construction work would be involved in putting experiment under way, hence civil engineers construction contractors, regardless of their sonal views as to the economic soundness or irability of the undertaking, have followed its gress with keen interest if not always with proval. That progress, we believe, has exceeded brightest expectations of the engineers who a part in the inauguration of the TVA.

Measured roughly in physical accomplishments, TVA engineers have chalked up a record of 13 ge dams completed and three more under way, 00,000 acre-ft. of flood storage provided, 00,000 kw. of new power generating equipment talled, 385 miles of 9-ft. navigation in service 265 miles nearing completion. Less spectacu, but no whit less important, is the record of river dies made to determine the best way in which use the waters of the Tennessee and its tribuies. By control of the river's flow on the basis of se studies the firm output of power plants has en improved, navigation depths have been mainned and flood crests have been reduced on the nnessee and also on the lower Ohio and Missisppi rivers.

Worth special note are the engineering and conuction organizations that have been built up within the TVA and the improvements in construction techniques that these organizations have produced. Outstanding is the exploration of foundations by removal of rock cores of such size as to permit men to descend into the hole for direct inspection of the rock, also the construction of a cut-off wall under Hales Bar Dam by cutting and concreting deep overlapping core holes across the river bottom.

This notable record is ascribable primarily to two factors: first, to the appointment of Arthur E. Morgan to be chairman and chief engineer of the Tennessee Valley Authority, a man who combined high engineering ability with the vision and idealism needed to inaugurate a great social experiment like the TVA; and second, to the availability of an unusually large number of high grade engineers due to the economic depression through which the country was passing at the time. Arthur Morgan could pick his engineering staff from a large and able group of engineers, and he did pick with great discernment. Nor did he let political considerations enter into his selection. The fact that that rule still is closely followed stands to the credit of the directors who have continued in control of the TVA. Also to their credit is the fact that so many of the original men have stayed with the organization. In less capable hands, the TVA might have degenerated into an agency with which they would not voluntarily have continued to be associated.

As it enters its second decade the Tennessee Valley Authority begins a new phase in which construction will play a much less significant part. The major dams and power stations are built. After the war the chief problem of the TVA will be that of finding constructive use for the resources that now are devoted in large part to war. It is a task in which engineers still can play a major part but a quite different one from what they played in the decade just closing. Those who opposed establishment of the TVA looked upon it chiefly as an agency designed to injure or destroy the power companies of the Southeast. At the war's end the TVA will have much power equipment and large manufacturing facilities for which there will be no immediate need. If the fears of the TVA opponents are not to be realized, vision and engineering ability of a high order will be called for in the years that lie just ahead.

ENGINEERING NEWS-RECORD WALDO G. BOWMAN, *Editor*

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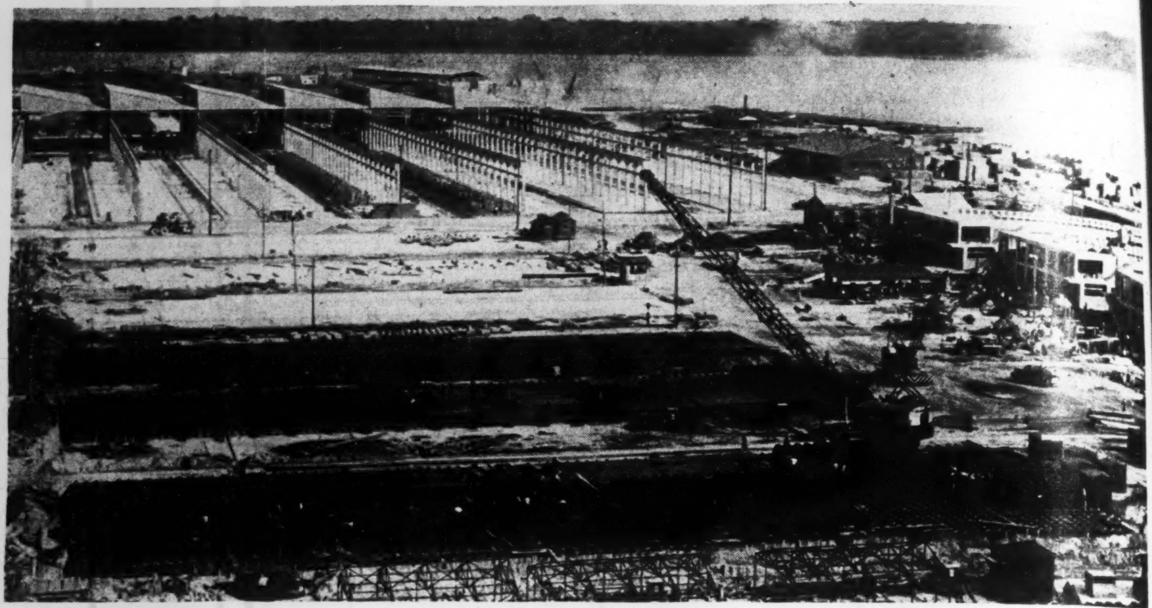


Fig. 1. A wide fabricating shop, storage area under shop cranes and large assembly platens make an ideal shipyard layout.

Plant Layout for Ship Construction

Contents in Brief*—Taking advantage of a late start on construction that gave unusual opportunities to profit by the experience of others, the operators of a Florida ship plant feel that they have the best planned yard in the country for constructing Liberty ships. Buildings use a minimum of strategic materials; overhead cranes operate on an unusual concrete structure; service facilities, including oxygen, acetylene and propane gases, are piped from central plants to all parts of the yard and to the ways.*

TAKING ADVANTAGE of a location in a good climate where labor and housing conditions are excellent, the St. Johns River Shipbuilding Co. laid out a completely satisfactory yard with six building ways for construction of Liberty freighters. The site selected is ample, spread out nearly a mile along the waterfront on the St. Johns River, at Jacksonville, Fla. The 1,000 to 1,500-ft. wide area is on the main line of two large railroads, one having access to each end of the site.

Part of the area was improved and used for shipping prior to selection of the site for construction of Liberty ships. Existing facilities were acquired and became the storage and outfitting section of the new plant.

One end of the yard is laid out in generous proportions for a straight line flow of incoming materials through fabrication processes to the ways. The general plan provides for rail delivery to long, narrow plate and structural-shape storage with hoisting in this area done by rail-mounted gasoline-powered cranes. Delivery to any of the several bays of the wide fabrication shop is made with rail cars from which overhead cranes handle the material through the shop and to fabricated storage. From the storage area tractor-drawn flat-bed trailer trucks haul the pieces to assembly platens, serviced by the full-revolving gantry cranes that are used at the ways.

At the other end of the yard area facilities are provided for outfitting the hulls. Boilers, machinery and fittings for the vessels move by rail to waterside warehouses, metal-working shops and direct to the outfitting docks or the ways. Full-revolving cranes on high gantrys handle the heavy loads.

Utilities, including cutting gases, are carried underground, or just above it in protected locations, throughout the work. Outlets are provided frequently to service all areas. On the ways, vertical risers with outlets at three levels, carry the utilities to points of easy access for those working on the vessel.

Straight-line flow

Raw material storage is provided on trackage along one entrance to the job, racks similar to those shown in Fig. 3 being provided for plate storage. Track layout in the yard makes it possible to employ rail delivery to any section of the fabrication building, but straddle-trucks are used for small or rush deliveries.

A 100 x 300-ft. mold-loft is located adjacent to the fabrication building but to one side, out of the line of flow of materials through the yard. This location makes it convenient to store templates not in use in the mold loft where they can be given constant attention.

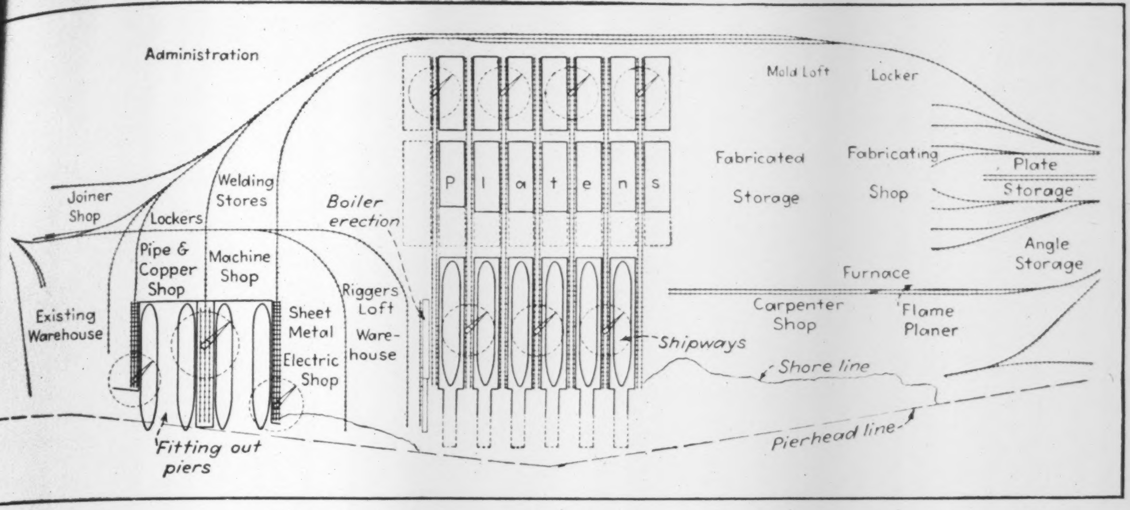


Fig. 2. Taking advantage of a site with railroad deliveries at each end, St. Johns Shipbuilding Co. laid out an ideal yard, piping all facilities underground to every part of the work. Tractor-drawn trailers haul throughout yard.

Fabrication is carried out under a sawtooth-roofed shed that is open at both ends to a height of 36 ft. to permit passage of overhead cranes with loads. There are eight 73-ft. wide bays in the building, each with a 10-ton capacity overhead-crane spanning 70 ft. The building is supported on a concrete frame that also carries the crane rail. These frames extend 60 ft. on the receiving side of the structure to permit unloading materials from cars and on the opposite side are built out over the fabricated-storage area.

Each bay of the building is equipped to do certain parts of the fabrication for each of the ships. The overhead cranes, supplemented by auxiliary hoisting devices at individual machines, handle the steel from cars into the shop and during the processing. Just outside one end of the "fab" shop are oil-burning furnaces for heating plates and shapes for bending. A steel "slab" 60 x 100 ft. provides ample space for hot bending of the ship parts.

Tractor and trailer transfer

After cutting, punching and bending as required the steel is moved to the fabricated-storage areas to await use. Racks or a paved area for storage is provided on either side of a 20-ft. wide roadway under the center of the crane span. A transfer section 60-ft. wide adjacent to the fabricating shop is left open for passage of trucks and transfer of material.

There are no railways to service the yard; plates and shapes are moved out of storage as required on 30- and 50-ton capacity tractor-drawn flat-bed trailers. Rubber-tired 30-hp. tractors pull the smaller trailers but crawler type 70-hp. units are used for the big loads. These tractor-trailer units haul to the assembly platens, the ship-ways and the outfitting docks, moving almost anywhere around the yard without the necessity for track and elaborate switching layouts.

Platens, or platforms, for preassembly of ship parts are at right angles to the line of flow of the material to the fabrication shop and storage space, but are in line with the ways so that the shipway cranes can be used to pick up assemblies and carry them to the ships.

Ways and platens are both 90 ft. wide and 120 ft. c. to c. with a 30-ft. space between adjacent units for operation of a 20-ft. rail-gage revolving crane on a high gantry. Cranes have a lifting capacity of 50 tons at about a 30-ft. radius, and travel nearly 1,200 ft. to service platens and shipways on either side of the track. Trucks operating between the legs of the gantry will do most of the hauling from platens to the ships. The heavy assemblies (up to 54-ton sections) are handled by two cranes picking up the load and traveling with it.

The assembly platens are on unreinforced concrete slabs. Steel plate was not available for working surfaces so 56-lb. relay rails were used, spaced 30 in. apart, as the support for parts during assembly. When the platens were built timbers were used to raise the platform to about 2 ft. above the concrete slab. On this open frame the rails were laid on edge to provide a narrow support for less interference with the work.

No advantage was found in the high platform as nearly all the work is of such size that little can be done around the edges. Workmen stepped through the openings, injuring themselves, and materials fell through. After the platens were in use a short time, this layout was changed to do away with the high platform. It was also found desirable to turn the rail so that the full width of the rail head was made available for support of the steel and to provide some space for marking out for assembly.

Concrete frame headhouses

Ways are unusually long to permit construction of larger vessels if desired. The 90-ft. wide section of the ways, used for construction, is 465-ft. long. The launching ways are an additional 200-ft. long to support the vessels to a point where the groundways are 6 ft. below mean high tide. Declivity throughout is $\frac{5}{8}$-in. per ft. The inshore 60-ft. length of the ways is a concrete frame, brick wall, headhouse that accommodates tool-rooms, transformers, offices and workers' lockers.

All of the ways, including the headhouses, rest on untreated timber piling driven to a bearing of 18 tons by the *Engineering News* formula. The

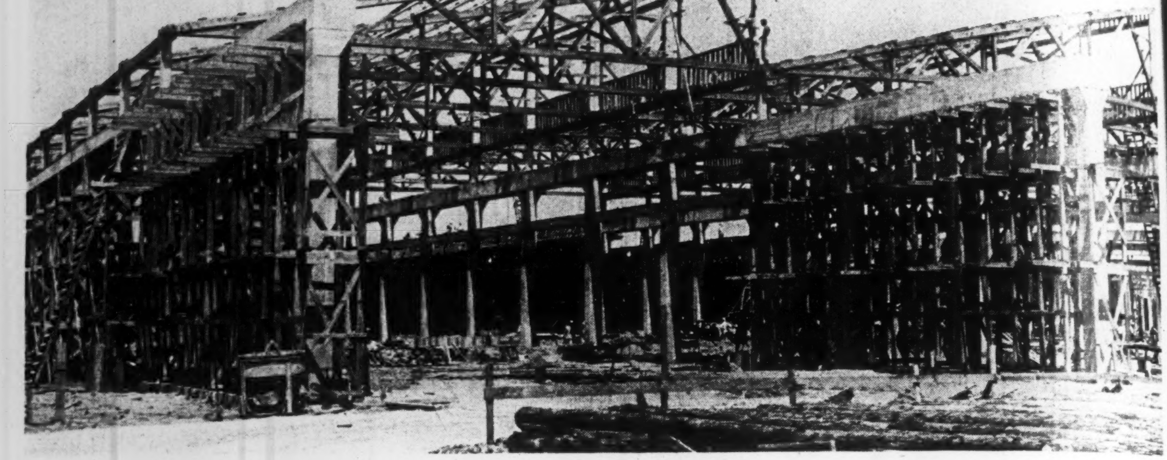


Fig. 3. Sawtooth roof of timber trusses and bar-joist purlins on a concrete frame covers the fabricating shop building.

shipbuilding section of the ways rests on pile bents spaced 4-ft. c.to c. under the center 47 ft. where the load is concentrated; alternate bents extend to the full 90-ft. width to carry the lighter loads outside the vessel proper. Supports for the outboard or launching ways are pile bents at 3- or 4-ft. centers as load concentrations require. Caps and framing of the outboard ways, of creosoted timber, were placed in the dry inside sheet pile cofferdams to assure substantial construction.

Piles for each bent were cut off level and the cap timbers set plumb. The forward top edge of the cap was cut with a food-adz to bring the timber to the declivity and exact elevation required. Decking is 4-in. thick timbers laid longitudinally with a little space left between planks for drainage. Ground ways, at 10 ft. either side of the center line, and the keel timbers are bolted through the deck and cap as shown in Fig. 6. On the outboard ways the declivity is compensated for in an oak wedge immediately under the ground ways.

Outfitting area

Ship-fittings, machines and parts move in from the end of the yard opposite that from which the structural members are delivered. Warehouses already existed on trackage along the waterfront and were taken over as part of the yard to provide space for early storage.

Making best use of the area available a sheet pile dock, (Fig. 9), with concrete paved deck accommodates ships at berths along both sides of a double U. Two 50-ton at 30-ft. radius gantry cranes operate on 20-ft. gage rail on the outside legs of the U, while a single, larger crane on a 30-ft. rail-gage gantry services both ships at the center of the dock.

At the head of the outfitting dock are a semi-connected machine shop and a pipe and copper shop each built on a concrete frame. These structures are each 150x200 ft., the

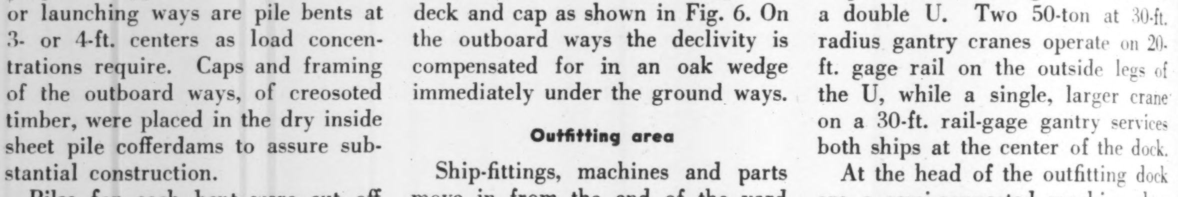

Layout tables
Plate punch
Burning tables
Flange press
Countersink tables
Bending roll
Flame planer
Bending roll
Plate punch
Keel bender
Layout tables
Burning tables
Double angle shear
Welding platen
Bulldozer
400-ton gap press
Travograph
Rails 80 ft. long
Welding tables
Layout tables
Double angle shear
Vertical plate punch
Horizontal punch
Cold cut
Burning table
Bending slab
Furnaces
Layout tables
Horizontal punch
Bulldozer
Shaped plates
Shell plates
Straight plates
Shell plates
Deck plates
Hatch end beams
Hatch girders
Superstructure
Shaft tunnel
Stiffeners
Stack
Foundations
Superstructure
Brackets
Bulkhead
Stiffeners
Deck floors
Girders
O.T. floors
Stiffeners
Drain wells
Floors
Stiffeners
Straight frames
Deck beams
Stiffeners
Frames
Cambered beams
Shaft tunnel
Stiffeners

Fig. 4. The machine shop is laid out to handle the fabrication of a particular part of the work as it moves through one bay. Parts handled are named below the bay through which they move.

00-ft. dimension corresponding to he width of the outfitting slips. The oncrete frame is connected through he two structures and supports a rane rail that is continuous over the 0-ft. opening between the buildings nd extends over trackage built at ither end of the structure. A cenral opening with 48-ft. clear height ccommodates 78-ft. span bridge ranes of 25-ton capacity in the achine shop and 10-tons in the ipe and copper shop. Several maller shops, joiner, sheet metal, lectrical and others are located earby.

All material delivery in this area s by rail, the cars passing under the verhead cranes at the principal shops or easy transfer of parts to the outitting docks. The tractor-trailer nits used in the platen-shipway area perates to some extent in the outitting yard but the general plan is o handle all materials on rail cars.

Facilities readily accessible

Service facilities necessary for ship onstruction are made readily available at every point of need throughut the yard. These include the gases for cutting: oxygen, acetylene and propane; compressed air for operation of pneumatic tools; water and lectricity. All facilities are piped underground or carried just above it in protected locations that do not interfere with operation of equipment or movement about the yard.

Oxygen is delivered in a liquid state in long bottles permanently mounted on a truck-trailer. At a transfer building, the liquid is converted to the gas form and introduced into a pipe system. A central generator manufactures the acetylene for use on the work. Propane, used primarily for heating pipe and metal in preparation for working, is also processed into a gas on the job. The latter is piped only to the fabricating, pipe and metal working shops.

Oxygen and acetylene processing stations are widely separated but the distribution lines for the two are parallel throughout the yard. Both mploy 4-in. dia. welded tubing for the main feeders, these reducing in size to as small as $\frac{3}{4}$-in. dia. threaded pipe for service outlets. Along the ssembly platens multiple outlets are paced at 40 ft. c. to c. The cutting gases are piped up on the ways with en vertical risers, about 40 ft. c. to c. on each side of each way. The risers have multiple outlets at three levels and bring all facilities to within reach of one 50-ft. length of hose. Use of the piping system eliminates long lengths of hose, hauling and handling of many individual tanks around the project, and saves both time and the gases, the latter due to no loss in partially emptied containers.

Compressed air for operation of pneumatic tools and machines is produced at one central plant. A bank of compressors provide 3,400 cu.ft. of air at 125 psi. The air is piped to most parts of the job through 12-in., 8-in. and 6-in. dia. welded tubing. Mains are interconnected at many points to get better capacity from the

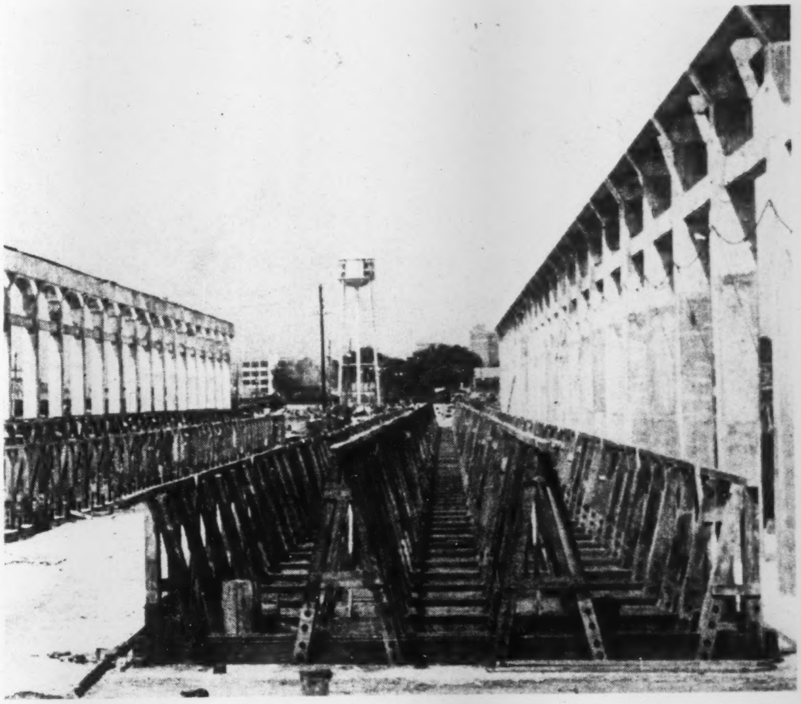


Fig. 5. Continuous concrete girders support bridge crane over fabricated storage. Ship parts are hauled to platens or ways on tractor-drawn flat-bed trailers.

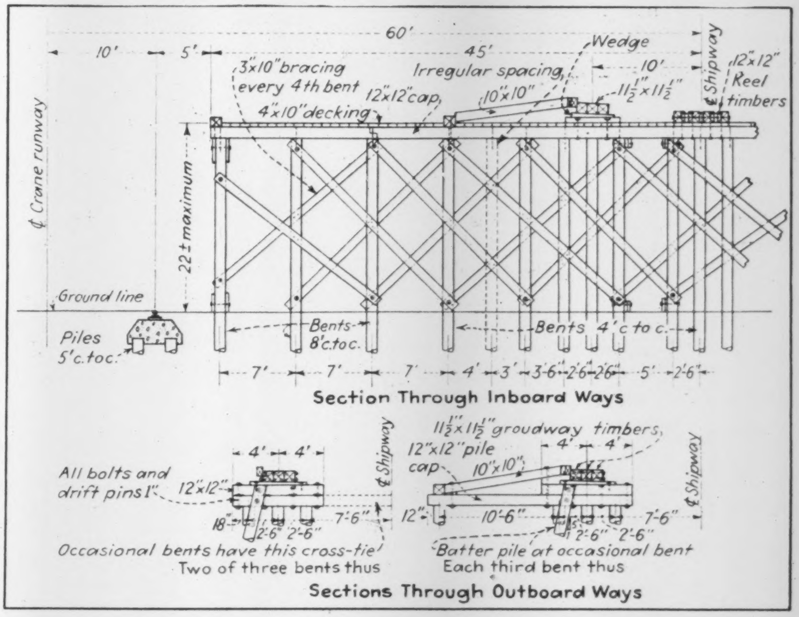

60'
10'
5'
45'
Wedge
10'
℄ Shipway
3"x10" bracing every 4th bent
Irregular spacing
12"x12" cap
10"x10"
$11\frac{1}{2}$"x$11\frac{1}{2}$"
12"x12" Keel timbers
4"x10" decking
℄ Crane runway
22± maximum
Ground line
Piles 5' c. to c.
Bents 8' c. to c.
Bents 4' c to c.
7'
7'
7'
4'
3'
3'-6"
2'-6"
2'-6"
5'
2'-6"
Section Through Inboard Ways
$11\frac{1}{2}$"x$11\frac{1}{2}$" groudway timbers
4'
4'
All bolts and drift pins 1"
12"x12"
18"
2'-6"
2'-6"
7'-6"
℄ Shipway
Occasional bents have this cross-tie
Two of three bents thus
12"x12" pile cap
10"x10"
12"
10'-6"
2'-6"
2'-6"
7'-6"
℄ Shipway
Batter pile at occasional bent
Each third bent thus
Sections Through Outboard Ways

Fig. 6. Illustrating modern design of pile supported shipways and launching ways.

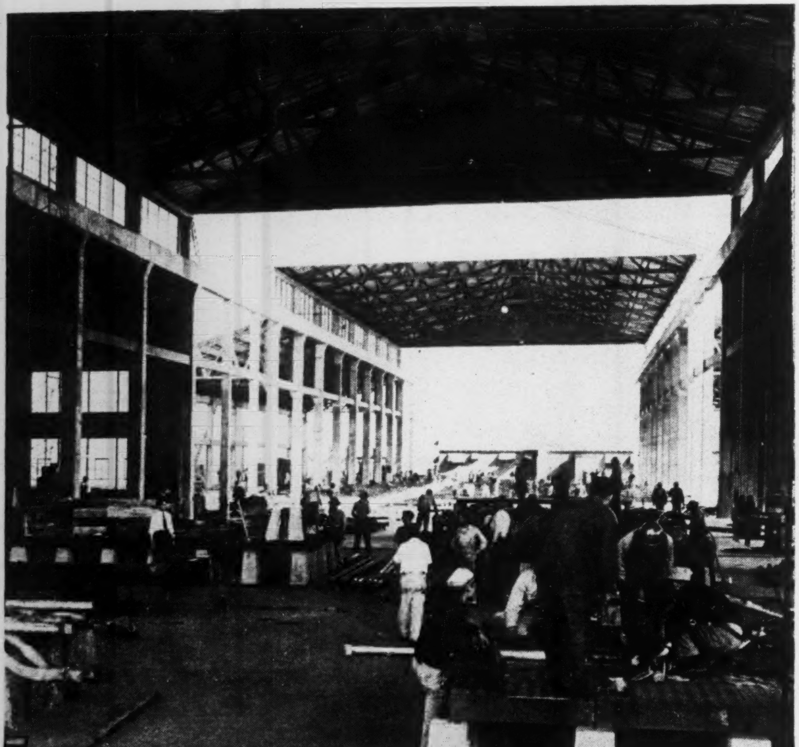


Fig. 7. Timber trusses above a concrete frame carry the roof for the pipe and machine shops. Crane runway is continuous through the two buildings.

entire installation and avoid local pressure drops. From the mains, 2-in. dia. and larger pipe rise to manifolds where connections may be made for the pneumatic tools needed at any location. A few isolated parts of the job, with low air demands, are serviced by individual small compressors.

Electricity from two sources

Electricity is obtained from separate 13.2 kv. circuits entering the job at different points and are kept separate throughout the yard. Main lines are 350 M circ. mil cables and the systems overlap so that each of several substations can be supplied from more than one power source.

Lines enter the job at 13,000 volts, and are stepped down at the main substations to 2,300 volts. This voltage is further reduced at transformers installed around the yard to the 440, 220 or 110-volt required for motors, tools and lights. A standby generator is installed to provide emergency light and a minor amount of power.

Water is taken from the municipal supply of Jacksonville, entering the yard via a 12-in. dia. line. Pressure in the pipe and water for emergencies is maintained by an elevated tank to which the water is pumped on entering the yard. An emergency water supply comes from a 10-in. dia. well driven to a depth of 1,140 ft. The flow is 2,300 gpm., with a temperature of 71.8 deg. F., and is tied into the water system through the pump house.

Mains throughout the area are 12-in. dia. with cross connections wherever practicable. Valves are provided on all sides of every inter-connection so that in case of breakage only a very small area need be shut off from service. Full pressure can thus be maintained over the rest of the yard for fire protection. Standard hydrants are provided at intervals throughout the job, more frequently in the shipways, warehouse and wood building area.

Training by doing

Incidental, but necessary, to the construction layout is a school area at one end of the yard. Here the forces required for ship construction, 90 percent of them entirely new to shipbuilding, are trained for their part of the work.

Some pre-employment training is given in a vocational school outside the yard but training on the site has been found to justify allocation of space for a school. Trainees can thus be shown actual production work on the ways and more satisfactory work attitudes developed. Students are put on production jobs during their school time but not to an extent to interfere with the training though about one-third of the training cost is offset by useful work.

Time of training has been reduced to two weeks average for shipfitters and four weeks for welders and burners. All welders must pass the American Bureau of Shipping tests before being put on production work. Classes are conducted for chippers and for riveting crews; supplementary courses, on the employee's time, are offered in blueprint reading, shipfitting, use and maintenance of pneumatic tools, mold-loft work and layout. All classes are enthusiastically attended. More than 2,600 men and women have been trained and gone into production work. Due to careful selection of personnel for training only a few have been lost to the armed forces or for other reasons.

Ship construction

General plan of ship construction at this yard is complete shaping, cutting and preparation of every piece of metal necessary for the hull in the fabrication shop. Pieces then move to the platens where small units are assembled; the small sections are matched with others on increasingly large assemblies up to the capacities of the handling cranes. A crew works regularly at one platen, doing the one portion of the work for all of the ships rather than all of the work for one ship. The truck-trailer method of moving makes it easy to transfer the material anywhere in the yard without extra handling or loss of time.

Bulkheads for the ship are welded and are completely assembled on the platens and carried to the ways ready to set in place. Side-shells are assembled in horizontal position on a mock-frame. The plates are all welded but the frames, above the inner bottom, are riveted.

Fore and aft peaks are completely assembled in upside down position and moved to the ways in 30-ton sections. Cargo hatch openings are framed into the deck plating and all assembled in large sections on the platens. Bottom plating and tank-top plating forming the inner-bottom are assembled on platens in sections the full width of the ship and in lengths up to 50 ft., with all piping installed. Completed inner-bottoms (up to 52-ton sections) are moved to positions on the shipway by two gantry cranes.

Disadvantages of late start

On the opposite side of the ledger to taking advantage of the experience of others in laying out the yard were several factors that delayed getting into rapid production. The available area, while excellent geographically, required an average fill of 5 ft. over the entire yard. Also necessary was the driving of 38,000 wood piles to support all structures and the gantry-crane tracks. The floor of the fabricating shop is on piles while storage areas and assembly platens required heavy concrete slabs.

The concrete frame, timber-truss roof and corrugated asbestos-cement sheathed buildings took longer to design and erect than conventional mill buildings that were used at the first yards constructed. No plate steel was allotted for use on platens, the less desirable method of a rail grid being used to support the work. Thus it is not possible to permanently lay out the principal parts of the work as is practical on platens fully covered with steel plates.

The personnel available for work on ship construction were all inexperienced and had to be trained. This was true of practically the entire force from management to common labor as all experienced ship workers were already employed. The top management and a few key men came from a drydock and repair yard and some workers with recent shipyard experience were attracted to Florida, but in general the job had to be done by inexperienced personnel.

Probably the lack of machines caused greater delay than did inability to secure experienced help. Ship construction was started and continued for many months, with crawler cranes instead of the gantries designed for the yard. Only two of the several essential bridge cranes were obtained for use during the first months of operation. Other equipment was correspondingly slow in arrival.

Design and layout of the yard was handled by Harry M. Hope Engineering Co. of Jacksonville with N. W. Green in direct charge. Construction was the job of Thompson-Starrett Co. of New York under D. J. O'Mahoney, project manager.

The St. Johns River Shipbuilding Company is headed by J. C. Merrill, president, and K. A. Merrill, vice president, both of Merrill-Stevens Drydock & Repair Company of Jacksonville. D. J. O'Mahoney is now general manager of the shipbuilding firm. Hull superintendent is Jim Long, one of the very few long-time ship builders at the yard.

The yard was built and ships are being constructed for the U. S. Maritime Commission. David R. Knapp is resident plant engineer at the yard. A. G. Vickery, vice chairman of the U.S.M.C., is in general charge of all ship construction.

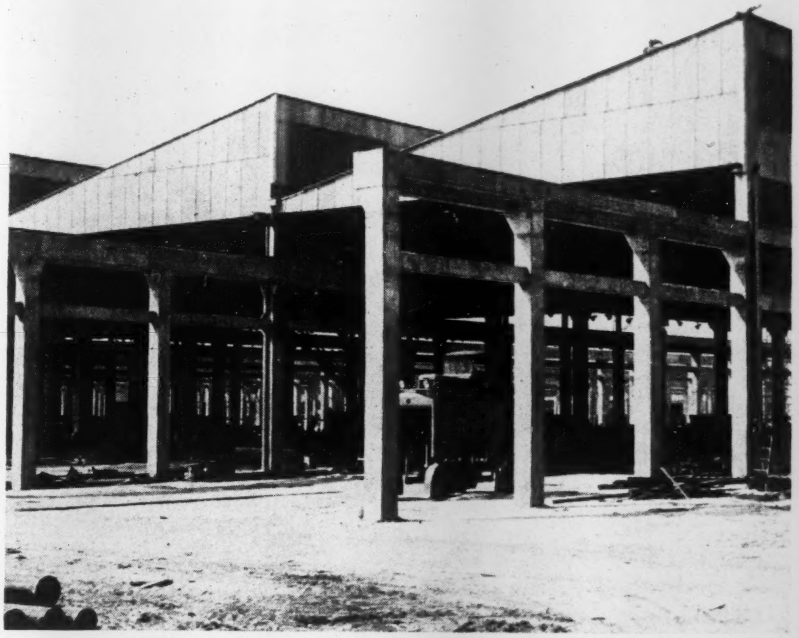


Fig. 8. Asbestos-cement sheathing covers the open fabricating shop. Overhead cranes move over this extension of the building frame to unload cars.

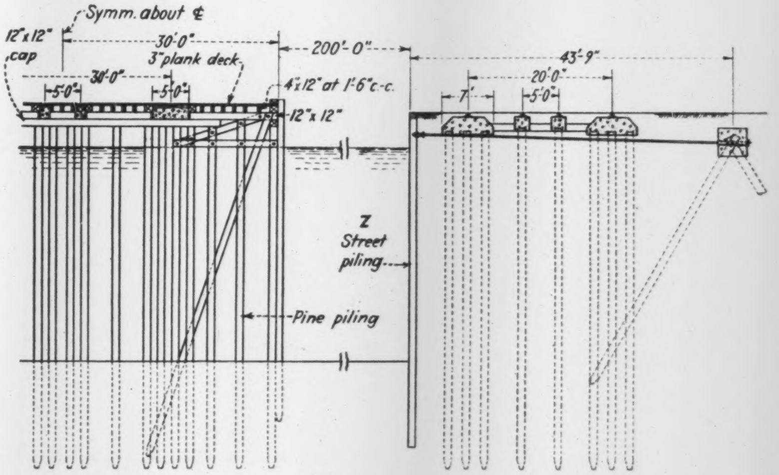


Fig. 9. Concrete beams support tracks for standard gage cars and gantrys at outfitting dock. Beams are continuous over the pile bents.

Bubbler Set for War Gas Detection

***Contents in Brief**—A sensitive bubbler test to get speedy identification of war gases has been devised by Los Angeles as part of its gas protection program. A multiple bubbler is used with reagents that give color changes when in contact with gases. The equipment is portable and can be used by operators having only little training in gas analysis.*

A BUBBLER SET for identifying the war gases most likely to be used on large cities of the United States is now in use in Los Angeles after this method was chosen as the safest and most reliable means, all things considered, of providing the earliest possible warning to the citizens in case gases are used by the enemy. An outline of the gas protection program at Los Angeles was published in *Engineering News-Record* Nov. 5, 1942, p. 631.

Admitting that a trained sense of smell is more sensitive than any chemical means, Los Angeles officials nevertheless found it impracticable to depend upon the sense of smell because (1) there are too few persons available with the necessary long and intimate experience with the characteristic odors, (2) there is risk that newly trained operatives may find it difficult to make nice distinctions between different odors during an air raid when confusion and panic are inevitable, (3) there are individual variations in the sense of smell, (4) in times of emergency olfactory nerves are highly susceptible to fatigue, and finally, (5) characteristic odors may be deliberately masked or unfamiliar agents may be introduced by the enemy.

Speedy, definite results insured

To provide sensitive means of getting speedy and definite results with highly portable equipment that can be used by operators having only relatively little training in gas analysis, the air flow method with a bubbler-type gas detector was adopted by the Bureau of Water Works and Supply to prevent casualties among treatment plant operators and repair crews, thereby to insure the continuous delivery of ample and safe water in times of emergency. This example was then followed by the city which has established 55 casualty stations for medical treatment and decontamination of gas casualties and has detailed a trained gas officer to each station. To supply these stations, 55 of the bubbler sets were assembled (at a total cost of $225 for reagents, materials and pumps) and one is now located at each station in charge of the gas officer. Stock bottles of the prepared reagents and distilled water are stored with the bubbler.

For on-the-spot analysis

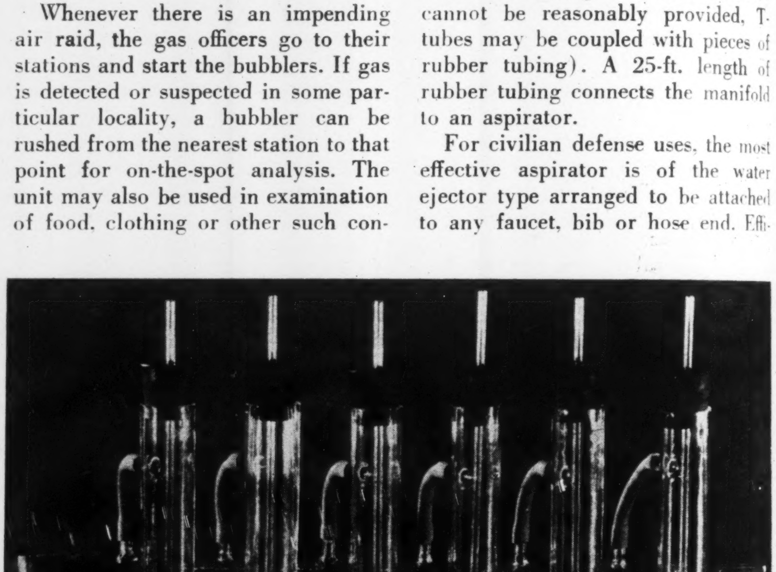
Whenever there is an impending air raid, the gas officers go to their stations and start the bubblers. If gas is detected or suspected in some particular locality, a bubbler can be rushed from the nearest station to that point for on-the-spot analysis. The unit may also be used in examination of food, clothing or other such contaminated objects found on the spot.

A multiple bubbler is used with reagents that have shown up best in comparative tests for sensitivity and have given the most striking color changes when in contact with gases. The six reagents chosen give an adequate coverage of the war gases considered most likely to be used.

How bubbler is made

The bubbler makes use of six 25x200-mm. filter tubes fitted with one-hole stoppers through which lengths of 4-mm. tubing extend nearly to the bottom of the tubes. The tubes also have side arms connected to a glass manifold from which six 6-mm. outlets are blown into a 1-ft. length of 8-mm. tubing. (If the manifolds cannot be reasonably provided, T-tubes may be coupled with pieces of rubber tubing). A 25-ft. length of rubber tubing connects the manifold to an aspirator.

For civilian defense uses, the most effective aspirator is of the water ejector type arranged to be attached to any faucet, bib or hose end. Effi-



Multiple bubbler set containing reagents, which is to be used for the identification of war gases in Los Angeles. The city has 55 sets, all of which are easily portable from one location to another for on-the-spot analysis.

cient suction also can be obtained from an automobile windshield wiper at idling speed or in extreme emergencies, the rubber tube can be fitted to the intake of a gas mask cannister and normal respiration will provide sufficient suction to operate the bubbler.

A table for the six reagents lists the characteristic reactions that will result from contact with 12 gases of which probably 3 or 4 are the important ones. The reagents in the six tubes are (1) gold chloride, (2) iodoplatinate, (3) permanganate, (4) methyl orange, (5) silver nitrate, (6) sodium sulphide.

Detection of new gases possible

In the event that a new or unidentified gas is encountered, it is highly important that a sample be collected for further laboratory analysis. This can be accomplished by disconnecting the bubbler, substituting a funnel packed with silica gel and allowing a considerable amount of aspiration through it. The funnel and contents are then capped or placed in an airtight container for laboratory analyses.

Within the city of Los Angeles, this work is under the general direction of H. A. Van Norman, chief engineer and general manager, Bureau of Water Works and Supply, aided as technical assistant by R. F. Goudey, who is sanitary engineer for the Bureau.

Power Program to Meet War Needs Outlined by Head of the WPB

The program of power development under which this country now is operating was outlined recently by Donald Nelson, chairman of the War Production Board, in a letter to Representative J. M. Coffee. Representative Coffee had asked Mr. Nelson whether material originally ordered for power projects in this country had been diverted to the Shipsaw power project in Canada. This information was desired because it had been charged in Congress that power projects in this country had been shut down to permit material and equipment to be supplied to the Shipsaw project. After stating that no material had been diverted from projects on this side of the border for projects in Canada, Mr. Nelson gave the following general outline of the WPB policy with respect to power projects under the planned power program.

Original program

"During 1941 and early 1942, we developed a power program for the United States involving over ten million kilowatts of new capacity to be installed during 1942, 1943, 1944 and subsequent years. This program would have provided power for war production, civilian requirements, reserves and a very large margin of surplus to take care of contingencies. In other words it would have been a practically risk-free power supply. By the spring of 1942 increasingly acute shortages of material and equipment had developed. It was evident that we could not achieve our war production goals for 1942 and 1943 unless some of the power and other heavy construction projects then scheduled to come into operation in later years were deferred.

"After careful study, we concluded that we could provide power for war production, essential civilian requirements, and a margin for contingencies with a much smaller program than the one originally contemplated. As a result of this study, it was decided that nearly four million kilowatts of the original program should be deferred. Approximately half of this, mostly private steam installations, was definitely cancelled last summer. The remainder, consisting of those federal hydro projects found to be unnecessary for the war program, were assigned low priorities to assure that they would not interfere with urgent programs. In the fall, when experience had shown that worthwhile progress could not be made with the low ratings, the federal hydro projects were likewise suspended.

"But even with these cuts the power program is tremendous. From January, 1942, through 1944, the approved power program includes installation of new capacity with a name-plate rating totaling 6,780,000 kw. Of this amount 3,695,000 kw. is privately installed, 3,086,000 kw. publicly installed.

"The bulk of the new public power installations are in those areas of the country in which you have indicated a special interest, the Pacific Coast and the TVA areas. From the beginning of 1942 through 1944 new publicly-owned installations in the Pacific Northwest will total over 600,000 kw. In the TVA area in the same period new public installations will total nearly one million additional kilowatts.

Deferments necessary to war effort

"As I have indicated, in selecting power projects for deferment last year, one principle was controlling. We were straining every resource to reach a peak rate of war production during 1943. Accordingly, projects which could contribute to that immediate objective had to be favored over the longer range projects which, however desirable, were not of assured value in the war program itself. Therefore, every public power project that could be brought into operation in 1942 or 1943 was continued. A substantial number of 1944 projects were also continued to provide a margin against contingencies. The remaining 1944 projects and all projects for later years were deferred. The Grand Coulee and Keswick units you referred to were among this group.

"There was no relationship between the halting of American power projects for 1944 and later years and the continuance of Shipshaw. Even if we could have arranged to divert the output of Canadian Allis Chalmers, Canadian Westinghouse and Canadian General Electric to this country, we certainly could not have justified stopping a 1943 Canadian project, necessary to meet a tight Canadian power situation, in order to complete later those American projects that would provide a power surplus here.

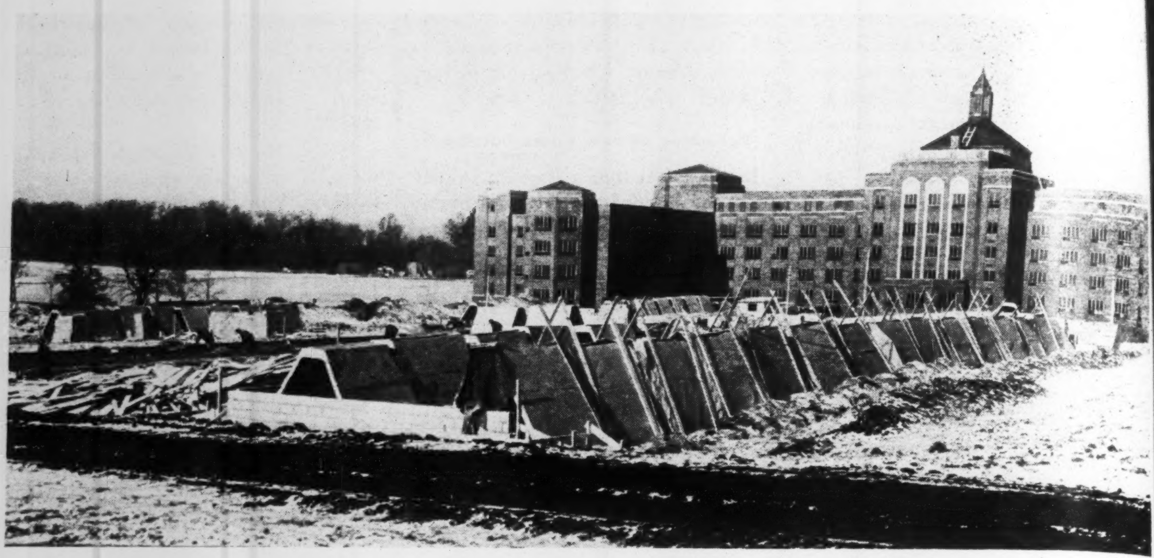


Fig. 1. Light A-frames covered with heavy paper housed salamanders that protected foundation work for this army hospital.

Winter Protection for Construction

Contents in Brief—*In constructing an army hospital in a northern location, five different contractors used two methods of protection on winter foundation construction and four distinct methods in building the walls. Two schemes provided for complete enclosure of the building sites, one contractor erected barriers to surround the foundation plot but added no roof, and still a fourth scheme was adding a barrier on each side of a wall and stretching a tarpaulin between the two barriers. Advantages of each method are discussed and the disadvantages outlined.*

Because of the resourcefulness of the supervising engineers and general contractors in devising schemes to overcome the difficulties of severe winter weather, an army hospital in an eastern state has been completed on schedule. Construction costs were naturally higher than for similar work undertaken during good weather, but the workmanship is considered excellent. Equally important, the project was completed within the few weeks allotted for the work.

The project was an enlargement of an existing hospital built a few years ago. In all 31 buildings of 14 different types were required, including wards, mess halls, nurses' homes, officers' quarters, and special buildings, all of permanent construction. Most structures are one-story high, although nine of two-story height were built. All the buildings are of the same general type with continuous plain concrete footings surmounted by concrete-block foundation walls and 4-in. brick walls with a 4-in. hollow tile backup. Windows are steel sash, floors are timber joists supporting double flooring separated by water-proof paper, and the roof is timber-frame construction covered by 1x6-in. sheathing and asphalt shingles. The buildings vary from 80 to 175 ft. in length and from 26 to 37 ft. in width.

Sub-zero weather experienced

Construction was started late last fall and temperatures as low as 20 deg. below zero were encountered. During days when sub-zero temperature prevailed, construction was confined to laying floors, adding windows, roof work, and interior work. However, both concrete and brick work successfully continued with temperatures much below freezing.

On construction of the foundations, the five contractors used one of two winter protection methods or did this part of the work on warmer days. All five contractors obtained concrete for the foundation work from a central mixing plant where the water could be heated by a steam boiler and the aggregate by live steam discharged from pipes buried in the material. When the concrete was placed at low temperatures, it left the mixing plant at a temperature of 75 deg. F. for distribution by agitator truck.

One protective method called for an extra wide foundation trench, with the dirt piled high on the side of prevailing winds, and just beyond the excavated earth was erected a temporary barrier 4 or 5 ft. high consisting of heavy paper over a timber framework. Salamanders were placed at regular intervals in the trench along both sides of the forms and kept burning for about 10 hours after the concrete was placed. This type of protection was cheap, required little temporary construction, and could be erected in a hurry. However, the protection provided was limited and a shift of the wind to other than the prevailing direction reduced the protection still more.

The second method of protecting concrete placed in the footings is shown by Fig. 1; this photograph was taken after the required concrete blocks above the footing had been added. With this scheme, the trench was made sufficiently wide to permit addition of salamanders along one side of the wall while the concrete was being placed. A-frame enclosures made up in 10-ft. long sections were placed over the trench. The A-frames were used only at the ends of each 10-ft. section. The frames were made of 2x4-in. timbers, and were joined on each side by three 1x6-in. timbers—two horizontal and one diagonal piece, and covered by bituminous-treated, sisal-reinforced paper.

The A-frame sections were added as the concrete work advanced and offered extensive protection against the weather. This type of enclosure required but little lumber, and the sections were built quickly and re-used many times. Furthermore, the sections could be left in place to provide protection while the concrete blocks above the footing were placed.

Stock piles of concrete block were kept covered with tarpaulins and, before being placed, the blocks were warmed for several hours by being stacked one block thick around a salamander. Mortar used in laying up the blocks was mixed by hand nearby. Mixing water was heated in steel barrels over open fires. The sand was heated by a wood fire in culverts made of old steel drums placed beneath the stock pile.

With the foundations for a structure complete, the joists and sub-floor were added during very low temperatures without protection against the weather. It was during the next operation or construction of the brick walls and tile backup that four different methods of temporary protection against the cold were used.

The method shown by Fig. 2 proved very satisfactory. It consisted of constructing on the sub-floor a temporary framework sufficiently high to be above the walls when they were carried to their full height for one-story buildings or to second-floor level for two-story structures. The eaves of the temporary framework extended several inches beyond the foundations. Thus, when tarpaulins were added over the framework and suspended from the eaves, building was completely enclosed and easily heated.

By suspending electric lights from

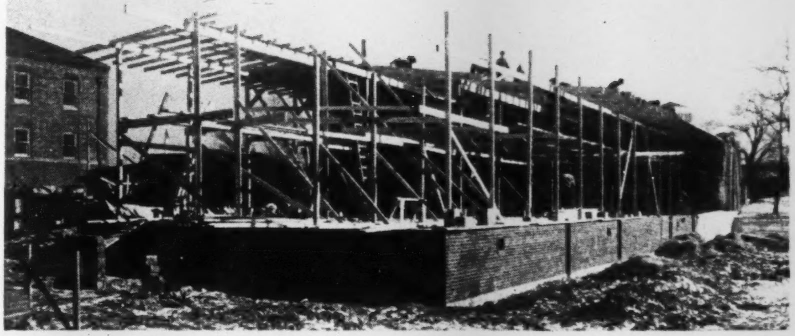


Fig. 2. With floor in place, a timber framework was erected to permit enclosure of the building with tarpaulins. The eaves of the frame projected sufficiently that the side tarpaulins hung outside the wall.

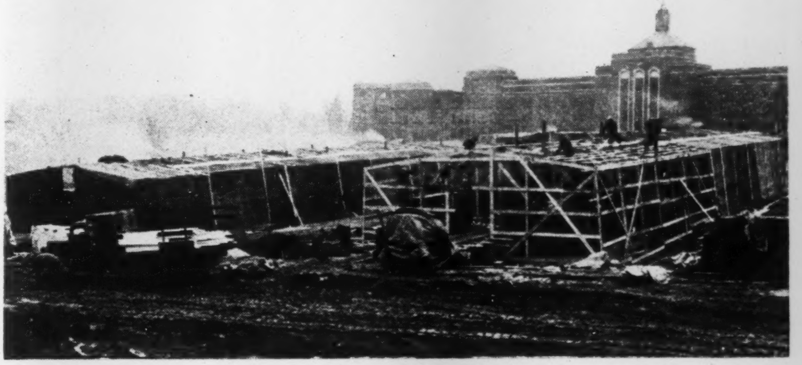


Fig. 3. A temporary framework that required posts outside the brick walls under construction offered a number of advantages. Walls for the building at the right have been completed and the tarpaulins are being removed.

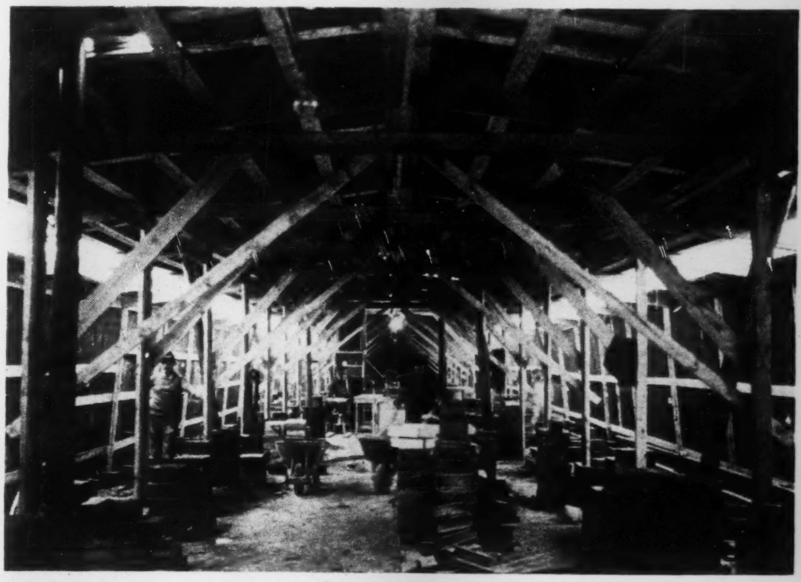


Fig. 4. Inside view of framework of type illustrated by Fig. 3. Above each wall under construction the tarpaulin was replaced with transparent paraffin paper to improve the lighting. The electric lights are to be noted, as are the pipes leading from salamanders also the working freedom provided.

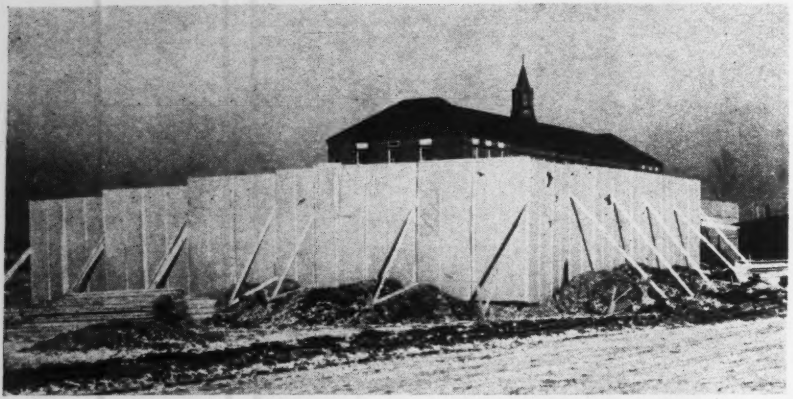


Fig. 5. A temporary barrier of heavy paper over a light timber frame completely encircling the site was used to advantage by one contractor. The barrier was built in panels easily moved about.

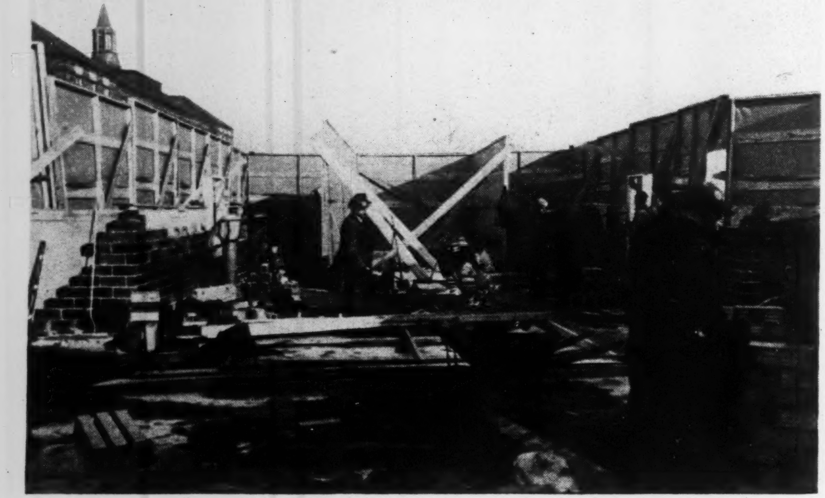


Fig. 6. When a barrier completely surrounding the site failed to prove effective against high winds and low temperature, an inner barrier was added and the work continued. Tiles for the wall were heated around salamanders.

the temporary rafters and adding salamanders on the floor at frequent intervals, an enclosure that permitted fairly rapid construction of the walls was available. By heating the brick with the salamanders and water and sand for the mortar, workmen could lay the brick work at very low temperatures. This method of protection also had the advantage of requiring no falsework or framing outside the building, but had the disadvantage of requiring considerable work in erecting the timber framework.

A second type of framework that permitted construction of the exterior walls under tarpaulins is shown by Figs. 3 and 4. This framework required posts outside the walls, but the total amount of lumber required was no more than for the first type. There was the added advantage that fewer interior posts were required, thus causing less interference in the delivery of materials.

Paraffin paper used for more light

The contractor using this system also went a step further and substituted transparent paraffin paper for the tarpaulins directly above the walls. This paper, which was about 1 yd. wide, greatly improved the lighting and speeded up the work, although it could only be used a few times. It should be noted that the roof was pitched for both types of enclosures to provide drainage and that the framework with wide eaves was preferred where a second-story was to be added, since the framing could be re-erected on the second floor much as on the ground floor.

Site enclosed by temporary barrier

A third successful protective method that offered a number of advantages is illustrated by Fig. 5. This system called for complete enclosure of the building by a temporary barrier wall 15 ft. high, but no roof. The barrier was built of 6-ft. wide panels of bituminous-treated, sisal-reinforced paper nailed over a light timber framework. The barrier was located about 3 ft. from the wall under construction. This spacing permitted salamanders to be used between the barrier and the wall; salamanders also were used inside the building walls and both the brick and tile were heated, as were the water and sand for the mortar.

Major advantages of the barrier wall over the other types of protection described were good daylighting, lack of trouble from the smoking salamanders, speed of erection and dismantling, and freedom from temporary bracing inside the walls. With a wide building, however, it was difficult to keep the site warm on an extremely cold, windy day.

To partially overcome this latter trouble, the addition of a second barrier inside the wall under construction as shown by Fig. 6, proved helpful. This second wall permitted less space within which to work, but greatly reduced the area to be heated and permitted operations to continue at a temperature much lower than otherwise possible.

The fourth protection scheme is illustrated by Fig. 7. It consisted of erecting paper-covered frames along both sides of the wall and stretching tarpaulins over the top. The panels were nailed to a framework straddling the wall. This arrangement offered sufficient protection when the temperature was very low—work continued despite snow or rain, and the panels could be erected and moved ahead quickly. There was the disadvantage that the lighting was not good and smoke from the enclosed salamanders was often troublesome, although a stove pipe lead from each salamander through the roof. It is to be noted that trouble from smoking salamanders was a complaint by the workmen against the other methods where a roof was used; this complaint was offered against both the oil and coke salamanders.

In summary, all the protective ethods described have decided disvantages, but they have the great vantage of offering sufficient protion to permit continued work at w temperatures. This advantage s extremely important on this rush oject.

The project was carried out by the ltimore, Md., District, of the iddle Atlantic Division, U. S. Enneers, Col. Clark Kittrell, division gineer, Col. Conrad P. Hardy, disict engineer, Captain McLand sher, head of the engineering dertment, Captain R. R. Kline, area gineer, and Lt. Will Brewer, execue officer.

The general contractors were: ovds Builders', Chicago, Ill.; Moyer ros., Altoona, Pa.; F. Hoffman Co., ilkinsburg, Pa.; Henretty Construcon Co., Pittsburgh, Pa., and F. & Y. uilding Service, Columbus, Ohio. unting, Davis & Dunnels, Inc., Butr. Pa., were the architect engineers r the project.

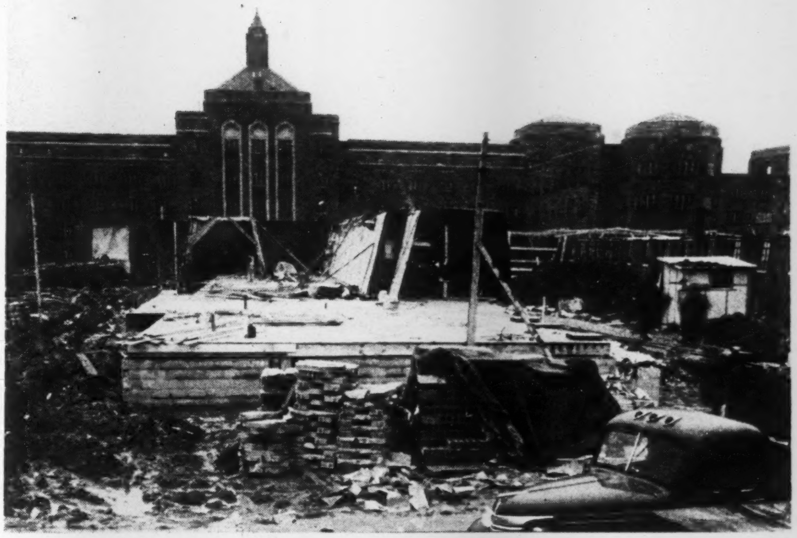


Fig. 7. By adding temporary panels along each side of a wall, stretching a tarpaulin over the bracing between the panels and heating the enclosure with salamanders, workmen were able to continue construction of brick walls even in bitter cold weather.

Concrete Construction is Replacing Timber in British Wartime Housing

Permanent house construction has been reduced as far as possible in wartime Britain, but housing of war workers has necessitated a number of new construction schemes in various parts of the country. For these, timber was replaced by concrete wherever possible, (1) in order to save imported timber, and (2) to provide protection against incendiary bombs. Details of 26 wartime housing schemes examined and compared by the British Cement and Concrete Association show a large measure of standardization has been accomplished in brick-concrete building of permanent houses.

Brick wall construction

External walls in these typical wartime houses consist of 9-in. solid or 11-in. cavity brickwork. Internal load-bearing walls are of $4\frac{1}{2}$-in. brickwork, internal non-load-bearing walls of $4\frac{1}{2}$-in. brickwork, hollow clay blocks or lightweight concrete blocks.

Concrete is used for floors, roofs and staircases. To save reinforcing steel in concrete floors and roofs, spans are rarely in excess of 14 ft. The number of different spans is reduced as far as possible where precast concrete units are used, in order to avoid many varied lengths of precast units. But concrete construction in place also demands limitation of span dimensions in order to save formwork.

Block design for economy

Flat roofs and labor economy both favor the building of houses in blocks of between four and eight. Variation of appearance is obtained by changes in building lines, cul-de-sacs and quadrangles. Doors, parapets and eaves receive special consideration to improve appearance and avoid monotony. Grouping of houses in blocks greatly helps to improve appearance.

In foundation laying, special care is taken to avoid settlement in view of the heavier weight and greater rigidity of concrete floors and roofs as compared with timber. Concrete raft foundations are used in wartime houses where the ground is liable to settle or is of poor load-bearing capacity.

Staircases are generally formed of precast concrete units, with special units for bull-nosed bottom steps, landings and winders. All windows are metal, set between precast concrete lintels and sills. Precast frames around windows have been found to improve the appearance of the houses. Precast chimney cappings have been used in some schemes.

Permanent structures

These houses are intended for permanent use after the war. In this respect they differ from temporary wartime houses, often one story buildings, with flat roofs, which may be converted into pitched-roof type houses after the war when timber for normal roof construction becomes available. The flat concrete roof has certain disadvantages in the matter of appearance, insulation and weight, but use of light-weight concrete has overcome the two latter difficulties. Appearance can be greatly improved by consideration of minor details.

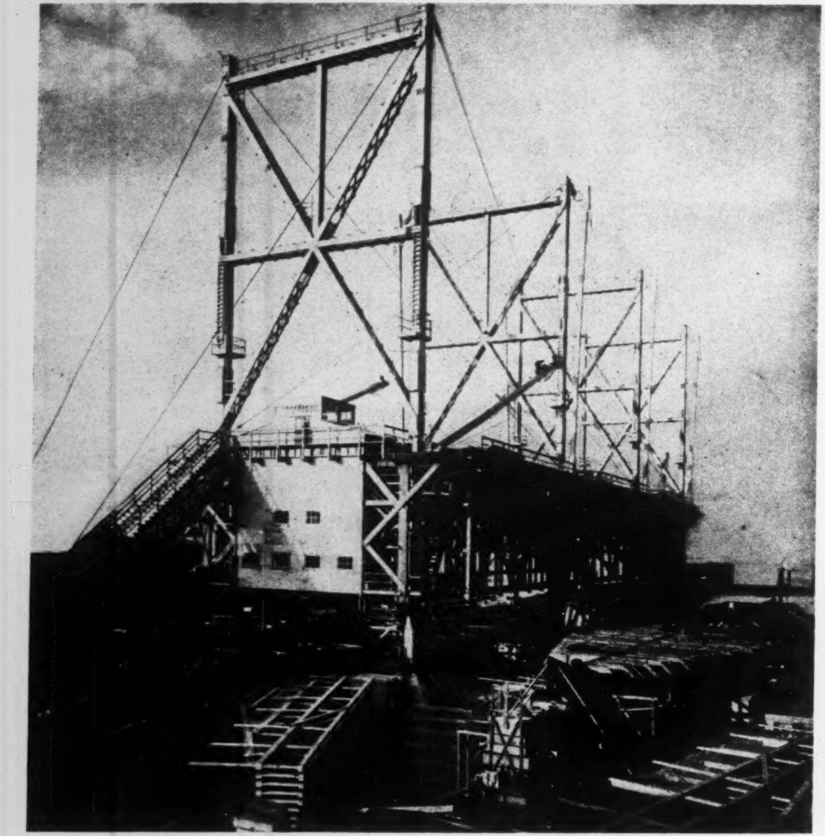


Fig. 1. Eight timber derricks with 90-ft. long booms swinging through 220 deg. aid in simultaneous construction of two 10,000-ton steel cargo ships. Through wells in the platform the derricks receive construction materials delivered by railroad under the platform.

Timber Derricks For Shipyard Use

***Contents in Brief**—Eight big timber derricks with 16x16-in. booms 90 ft. long are being used to construct steel ships at a Canadian shipyard. They are operated by ordinary swing mechanism, except that there are no masts; the lower ends of the booms operate on swivel joints and the tops are guyed to eight built-up timber columns spaced evenly along the two edges of a 68x318-ft. elevated timber platform. The beams swing through 220 deg. and each can handle a 10-ton load at a 42-ft. radius.*

AT ONE OF THE MOST MODERN shipyards in British Columbia large timber derricks are employed for placing steel and machinery in the ships. The booms are 16x16-in. timbers 90 ft. long. They swing through an arc of 220 deg. and each boom is capable of handling a load of 10 tons at a radius of 42 ft. They have a maximum radius of 85 ft.

The plant is laid out so that eight of the derricks, four on each side of a large wood-frame working platform, may be used in the construction of two 10,000-ton steel vessels simultaneously. The booms are operated by the ordinary swing derrick mechanism, except there are no masts. The lower ends of the booms operate on swivel joints and the tops are guyed to the columns. A 12-ft. dia. bull ring with one spoke and guided by small cast iron rollers is mounted about each column with its center about 2 ft. outside that of the column.

The platform or working deck is 68 ft. wide, 318 ft. long, and on a 3.5 percent slope to match the slope of the ways. It is supported at a height of about 32 ft. above ground level by the eight columns that extend up through the deck to serve as masts for the derricks.

The columns are spaced 100 ft. apart in two longitudinal rows of four each; the transverse spacing is 50 ft. center to center. Each column rests on a massive block of concrete supported by 16 wood piles of 30-ft. length. Eight 1¾-in. dia. anchor bolts hold down each built-up steel footing connection, which is fastened to the column by 4-in., malleable-iron. shear plates and ¾-in. bolts. Each column is made up of two pair of 6x24-in. timbers, spaced 12 in. apart and tied together with 12x24-in. filler blocks. The columns are built up in four sections with staggered joints and with 6x24-in. splice plates 8 ft. long.

Column bracing

To resist the stresses set up by the swinging booms, each pair of columns is braced transversely by timbers in the form of an X, and by latticed level braces at the top and center; a hanger joins the top transverse member and the center of the X. Each diagonal member of the X consists of two 6x18-in. timbers latticed together by 2x4's. These pieces are fastened to the main 6x18-in. pieces with 2½-in. dia., split ring connectors. The two horizontal members are made up in a similar manner.

On the top of each column is a welded steel bracket for attachment of the top lifting block used in handling the booms. There are also stretching screws carried through the post heads for the 1½-in. wire ropes, which take care of the longitudinal "trucking." The stretching screws in reality are 8-ft. long, 1¾-in. dia. eyebolts used to keep the diagonal guys tight. They are placed at both the top and bottom of the columns and are connected by the 1½-in. diagonal guys. Wrenches are used to screw up the large nuts on ends of the eyebolts, making their somewhat similar to the use of mbuckles.

Trusses also of timber

Framed longitudinally between the lumns and on their center lines are nber trusses with the top and botm chords each made up of two eces of 5x15-in. members spaced ½ ft. center to center of the chords. each end of the structure the usses are extended past the colnns 9 ft. making an overall length 318 ft.

Spanning transversely and framed to the longitudinal trusses are four mber Howe trusses in each of the ree bays. The trusses are on about)-ft. centers with those nearest the olumns are 5 ft. from the centerline those members. At each end of e platform and 5 ft. beyond the colmns similar trusses are used. Each ansverse truss is 68 ft. long, which eans that the trusses are cantilevered ft. beyond the longitudinal trusses. he top and bottom chords are made p of two pieces of 4x14-in. timbers nd the chords are 8½ ft. center to enter. The panel lengths are about ft.

The purlins consist of two longitudinal 3x16-in. timbers at the panel oints of the transverse trusses and hey are knee braced to these members. Over the purlins is used a laminated 2x5-in. deck with two 15x30-ft. vell openings in each bay. These vells are at the middle of the bays nd the inner edge of each well is 8 ft. 9 in. from the centerline of the structure.

Narrow gage tracks run from the fabricating shop and the length of the platform directly under the wells. Cars on the tracks supply plates and other construction materials, which are picked up through the wells by lines from the hoists.

Deck for working platform

The deck, which was designed for a 60-lb. live load, is used as a working and loading platform. Access to the platform from the ground is by an inclined wooden ramp at the land or bow end of the structure and by eight zigzag stairways, one at each column.

There are 8 derrick hoists below the platforms, one to each derrick, and these are housed in a special room at the landward end of the structure. The units are double-drum, friction hoists with extra powerful swinging gears. Two hoists are built on one frame, and placed back to back, taking their power from a single motor.

All timber used in the columns, trusses, purlins, bracing, etc., are of Douglas Fir, and for the most part of select structural grade. About 256,000 bd. ft. of lumber was required for the unit of eight derricks, in addition to the laminated deck. Split ring and shear plate timber connectors are used at all splices. About 23,000 of these connectors were used for each unit or gantry.

Erection procedure

In erection a transverse bent consisting of two built-up columns with the framing between them was set up as a unit by the use of gin poles, derricks and guy lines: the two 138-ft. posts and related bracing weighed over 40 tons. When in place, this unit was used as a gin pole for the next units in line. When two bents had been erected and guyed, the outside framed trusses were raised and fastened to the columns. The transverse trusses were next placed in position between the outside or longitudinal trusses, and finally the decking was added.

Personnel in charge

Construction of the platform and derricks was planned and supervised by W. D. McLaren, general manager of the shipbuilding firm, the name of which may not be mentioned due to wartime censorship. Charles T. Hamilton, consulting engineer of Vancouver, B. C., was responsible for preparation of the detailed design of the structural frame.

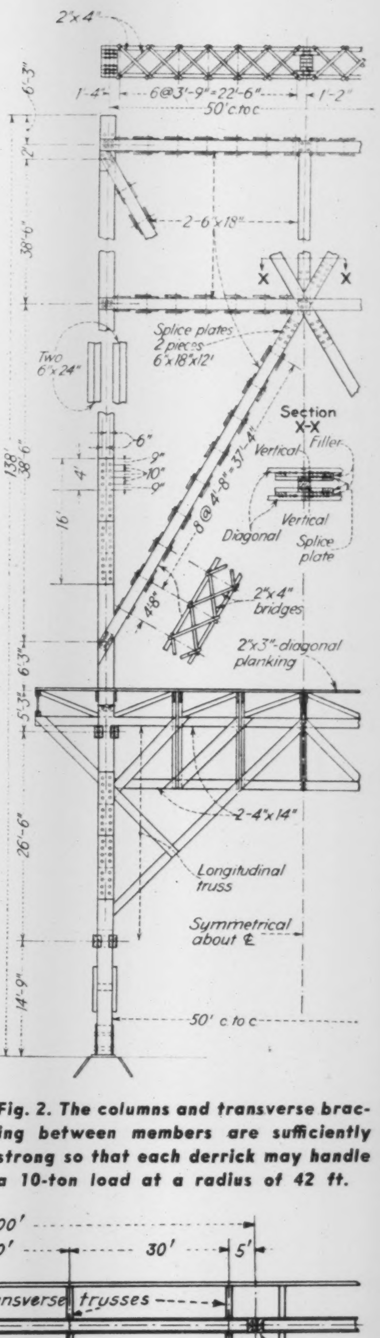


Fig. 2. The columns and transverse bracing between members are sufficiently strong so that each derrick may handle a 10-ton load at a radius of 42 ft.

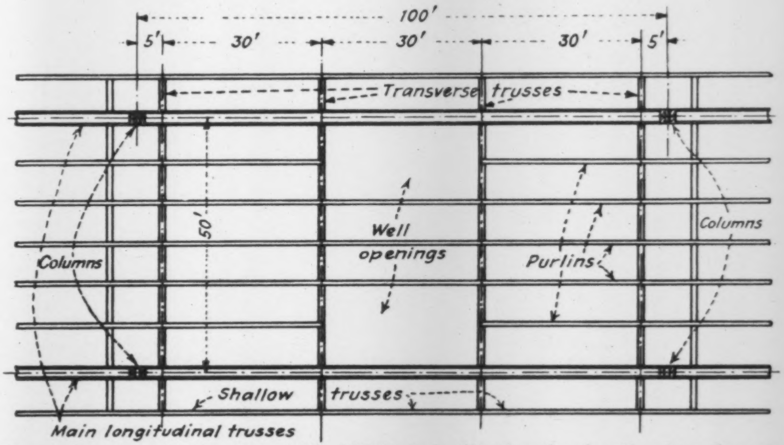


Fig. 3. Framing plan for the middle 100-ft. bay. The framing in other bays is very similar. Narrow gage cars are spotted under the well openings for unloading.

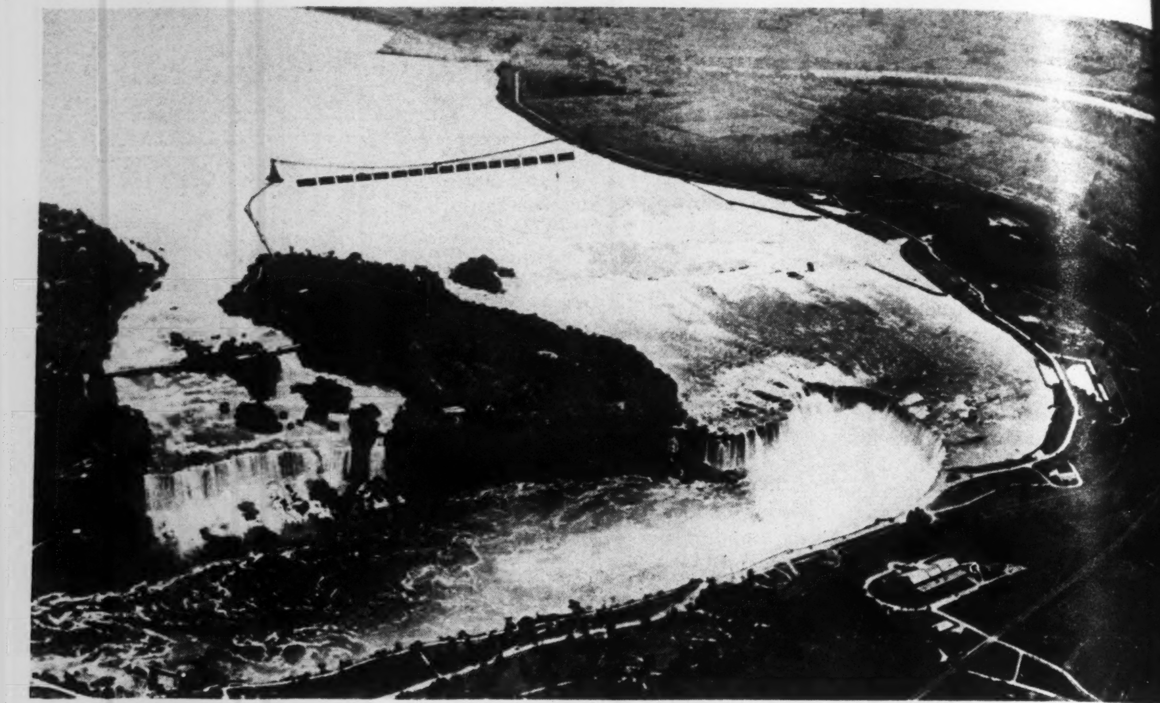


Fig. 1. Weir (located by the dash line) was built by a cableway spanning from artificial island to the Canadian shore.

Long Weir Increases Niagara Falls Power

***Contents in Brief**—Production of power for Canadian and American war industries will be increased by a 1,500-ft. submerged weir constructed to obtain maximum benefit from the water diverted around Niagara Falls. In constructing the weir, which is located above the falls on the Canadian side, 10,000 cu.yd. of stone was placed by a 2,600-ft. cableway, with one traveling tower on the Canadian shore and the other on an artificial island in swift water several hundred feet from the American side. Construction of the island required building a 2,200-ft. causeway of rock.*

To OBTAIN additional hydro-electric power for their war industries, Canada and the United States have recently carried out a joint program to obtain the greatest benefit from the diversion of water around Niagara Falls, and at the same time protect the beauty of the site. The $1,000,000 project is in keeping with the international agreement of last year to increase the diversion for Ontario plants to 50,000 cfs., and that for American power to 32,500 cfs. by stepping up the total diversion from 56,000 to 82,500 cfs. The project is also the first stage of the plan proposed several years ago for protecting the natural beauty of the area by increasing the flow over the American falls and at the flanks of the Canadian falls and reducing that at the center of the latter.

Major part of the present work was construction of a 1,500-ft. long submerged weir above the Horseshoe falls. This weir, which is from 5 to 10 ft. high and 40 ft. wide at the top, will be covered by about 6 ft. of water during the lowest flows, and will raise the pool elevation on the United States side by 1 ft. It extends in a straight line from a point about 400 ft. from the Canadian shore to a point about 500 ft. from an artificial island in the center of the river. The upstream face is of rock, not less than 3 tons in weight, the middle section of 100 lb. minimum stone, and the downstream portion of stone ranging from 3 to 10 tons. (Fig. 2.) In all 10,000 cu. yd. of stone was required.

Because of the swift currents a 2,600-ft. span cableway was constructed for placing the rock. The

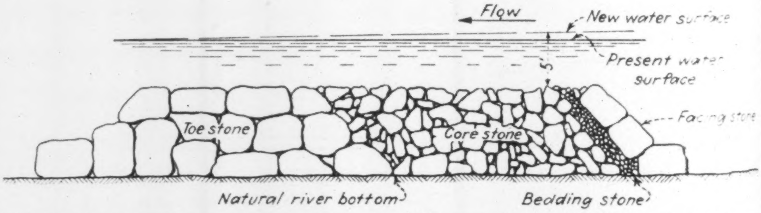


Fig. 2—Cross section of submerged weir built across Canadian channel of Niagara River above Falls.

nadian tower is located about 100 inland but that of the American is on an artificial island several ndred feet upstream from Goat and. Such a plan meant that to vide access to the artificial island 2,240-ft. causeway of rock had to constructed upstream from Goat and.

This causeway, which has three nouts about 25 ft. wide, averages out 5 ft. in height; for its conuction, stone was transported in -dump trucks to the upstream end Goat Island. For the first few hund feet, or until the first turnout reached, the trucks backed along causeway to dump their loads at end. The fill material was then ead and compacted by a bulldozer. constructing the last part of the useway the method was very simiexcept that the trucks traveled to last constructed turnout before ning around. By such a method contractor was able to build about 0 ft. of causeway each 14-hr. day th twelve to fourteen 10-ton trucks d one bulldozer.

At many points, stone for the causey was placed in currents as swift 6-mph. Use of large stone of 150 to 3 tons in weight for the bottom urse and similar stone plus 5 to 10 rcent of fines for the top proved ry satisfactory. Construction of the useway required 21,000 tons of ne, and once it was complete conuction of the artificial island folwed.

Island built about wood cribs

The artificial island includes two ck-filled cribs each 160 ft. long, ilt throughout of bolted 10x10-in. mbers, except for the 6x10-in. grilge planks. The cribbing required 8,000 b. ft. of lumber. Completely rrounding the cribbing and clear it, a rock barrier roughly 10 ft. de at the top was built. This barr was constructed of stone, each ighing more than three tons, and percent of them more than five ns.

The artificial island was built by st placing the stone outside of the ibs on both sides and at the two ds. With this stone in place, an ea was available where the conuction crews might work, free of nger from the swift current. Rockfor the island totaling 17,000 cu. was delivered by trucks operating er the causeway. After the cribs were completed the space between them and the barrier was filled with rock.

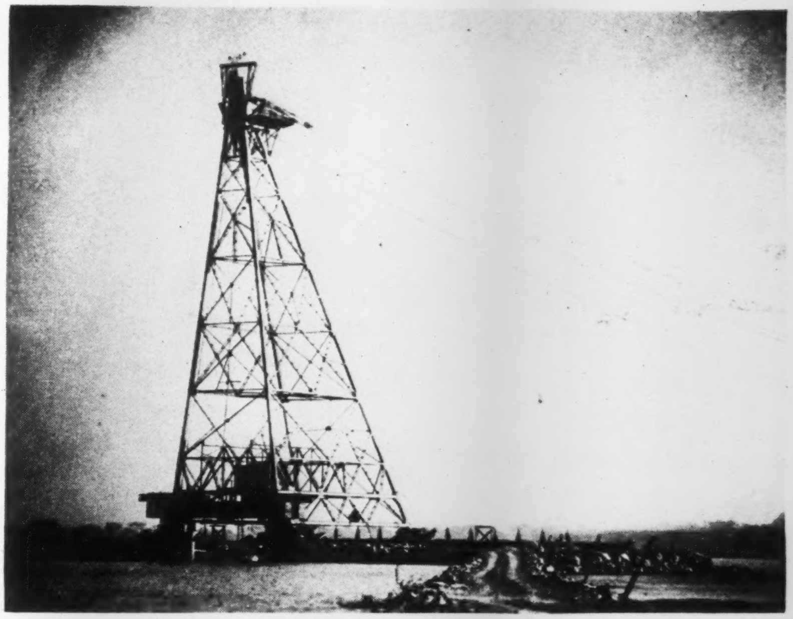


Fig. 3. Tail tower of cableway on artificial island. Cables are 2½-in. locked-coil type for main track.

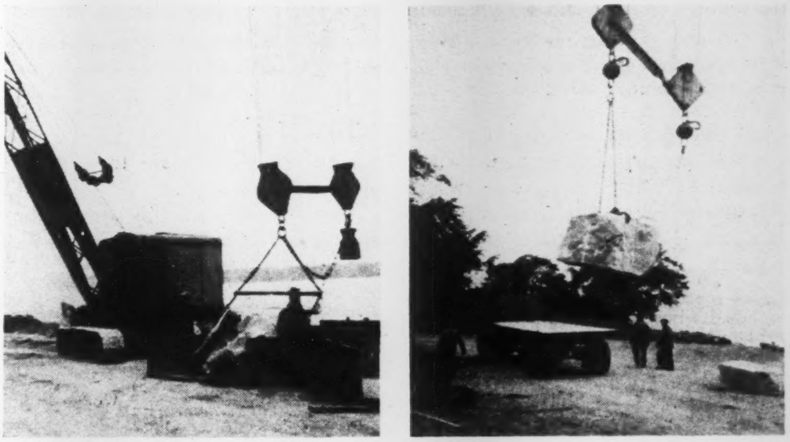


Fig. 4. Rock was handled by cableway, both by skip and hooks. Skiploads were as heavy as 15½ tons, while single stones up to 10 tons were lifted by the hooks.

The two 155-ft. high steel towers required for the 2,600-ft. cableway were those that had been previously used for placing the concrete for Conchas Dam in New Mexico and for constructing the outlet works at Denison Dam on the Red River of Texas. The towers were delivered torn down, that on the Canadian shore being erected by stiffleg derrick, and that on the artificial island by truck crane, operations on the artificial island being somewhat complicated due to the small working area available. Gin poles and gantry cranes were used to erect the higher members of the towers. By mounting the towers on rails 160-ft. long they could be moved about 100 ft. in a direction at right angles to the cableway span.

Cableway erection difficult job

With the towers erected, the problem of rigging the cables had to be met, and it was complicated by the long span, the small clearance of the cables above the water, the swiftness of the current, and the proximity of the Falls. A kite was used to carry the first line across the river. The initial kite line, a ¼-in. hemp cord, broke.

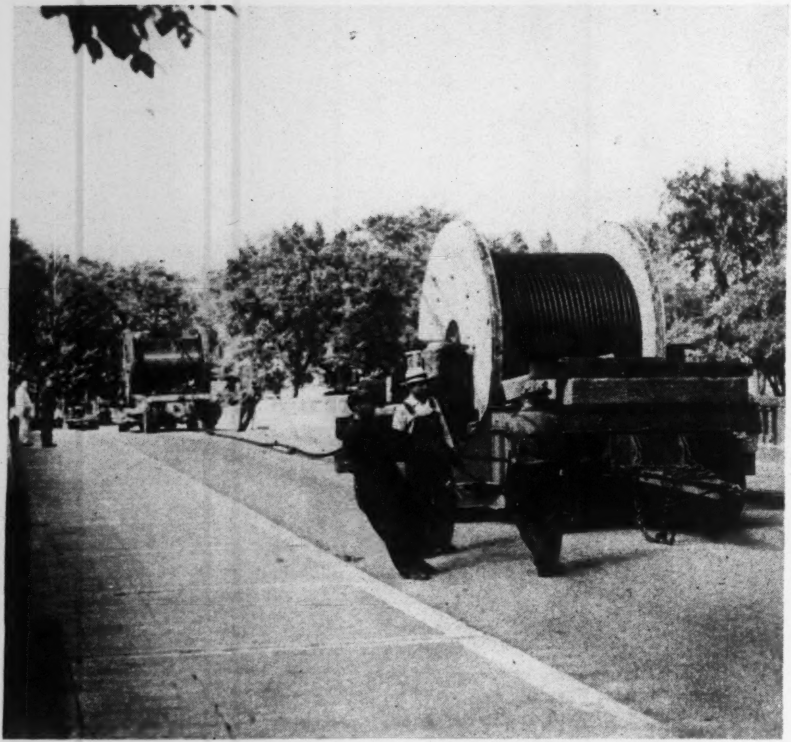


Fig. 5. Taking the main cable out to Goat Island over the old park bridges. Because of the great weight, the cable was wound on two spools and towed to the island on widely spaced trailers.

but a second trial with $\frac{1}{32}$-in. piano wire was successful. The piano wire was used to haul a $\frac{1}{16}$-in. wire across, and successively a $\frac{1}{8}$-in. steel aircraft cord, and $\frac{1}{4}$-, $\frac{3}{8}$-, $\frac{1}{2}$-, and $\frac{3}{4}$-in. wire ropes.

The $\frac{3}{4}$-in. line, strung between the bottom of the tail tower and the top of the head tower was then used as a messenger line, on which one-half of a double $1\frac{1}{4}$-in. wire rope was pulled to the Canadian side. The second half of this line was dragged across the river bottom as an experiment to determine if this procedure would be feasible with the $2\frac{1}{2}$-in. main track cable, which was of locked-coil type. The rapidity and success of the experiment warranted its use with the main track and other lines. In pulling the main track from the American to the Canadian side, the large bridge socket casting and the forward end of the cable were held out of the water on the $1\frac{1}{4}$-in. double messenger to prevent snagging on the bottom. By this precaution the downstream sag of the large track cable, weighing 15.2 lb. per ft., was slight, whereas several of the lighter lines bellied as much as 250 ft. downstream when permitted to sag into the river.

Approximately 250 tons of counterweight was in place on each tower before adjusting the main track cable to its operating sag.

After erection of this cable, the 1-in. dia. inspection tramway track cable was dragged across the river, and hung from outriggers on a line 10 ft. downstream of the main track. The main endless haul, hoist, and dump lines, and the endless haul for the inspection tramway were then strung. Meanwhile, the double $1\frac{1}{4}$-in. messenger was cut in half at the tail tower, one half being pulled in, and the other half raised to the top of the tail tower for use as a messenger in stringing electric power and control cables on outriggers 10 ft. upstream of the main track cable. The electric cables consisted of a 3-conductor, 2,400-v. power cable, and a 20-conductor, 440-v. control circuit cable; these were attached to a 1-in. dia. galvanized wire rope, and all pulled as a unit across the river on the $1\frac{1}{4}$-in. cable.

The main cable supported a stone skip for placing the smaller stone and a chain with stone hooks for placing the larger stone. The hoists and controls for handling the skip and hooks in the stone placing operations were controlled at the Canadian tower by an operator who received instruction by 2-way radio from a foreman riding in the inspector's car. All of th stone was delivered by truck to th Canadian tower. Single stones weighing 3 to 10 tons and skiploads totaling $15\frac{1}{2}$ tons were handled by th cableway. Loads were transported a 1,250 fpm. and hoisted by a 5-par falls at 250 fpm. By means of th cableway, about 400 tons of ston were placed in the average 10-hr. day (and some days as much as 500 tons with a crew of 10 men, not countin those at the quarry.

After the weir has been in place sufficient time to permit complete studies of its effects, and the effec of ice on the weir, the cableway wil be taken down and the 2,200-ft. causeway removed. The artificial island will remain in place, and will b landscaped.

Project financed jointly

The project was financed equally by the United States and the Ontario Hydro-Electric Power Commission, and was under the general direction of a construction subcommittee of the United States-St. Lawrence Advisory Committee and the Canadian Temporary Great Lakes-St. Lawrence Basin Committee, whose American members were: Colonel Geo. R. Goethals, District Engineer of the Buffalo District, U. S. Engineers, and Roger B. McWhorter, chief engineer of the Federal Power Commission; Canadian members were Otto Holden, chief hydraulic engineer, Hydro-Electric Power Commission of Ontario, and C. G. Cline, senior hydraulic engineer, Dominion Water and Power Bureau, Department of Mines and Resources.

Mr. Cline and Major Harland C. Woods, International Relations Division, U. S. Engineer Office, Buffalo, exercised office control of the work. E. M. Robbins, associate engineer, supervised the U. S. field work, and E. K. Beam, resident engineer, the Canadian field work. A. J. Eldridge, Columbus, Ohio, was consulting engineer on the cableway. The United States construction work was performed under contract by the Cleveland office of Merritt Chapman & Scott; the Canadian tower was erected by the Dominion Bridge Co. Rigging of the cables and placing of stone for the weir was done by field forces of the Ontario Hydro-Electric Power Commission, D. Forgan, construction engineer.

Mathematical Shortcuts for Engineers

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***ntents in Brief**—Engineers find almost constant use for empirical mulas that will provide solutions of sufficient accuracy, without involving ecessary labor. Those given here for logarithmic, exponential, trigonomet- and hyperbolic functions are both useful and suggestive.*

VALUABLE PART of the training and ctice of engineers is—or should —the writing of working formulas fit tabulated or plotted data. Such pirical formulas are useful for fur- r analysis, also for devising short- ts in computations. The governing nsiderations are simplicity of form, nvenience of application, and con- tent—or sufficient—accuracy. As s type of problem is somewhat for- n to the field of the pure mathe- tician, the engineer is left largely his own resources in developing the t of devising streamlined working rmulas for his own use.

As an illustration of the potentiali- s of this comparatively unexplored ld of applied mathematics, the riter presents here some simple em- rical formulas for various non-alge- aic functions used by engineers. om these formulas, many useful nctions and relations may be read- y calculated when tables are not at nd, also in some cases more con- niently than by the use of tables. he formulas here presented will yield sults accurate within 1 percent, ex- pt where otherwise noted. Numer- al examples are included to illus- ate the convenience and range of efulness of the formulas.

Formulas for sines and tangents

From the tabulated values of the tural sines and tangents of angles, mpirical formulas of any desired nge and degree of accuracy may be itten. The following formulas are od within 1 percent or less for all gles from 0° to 90°.

If the angle is given in degrees and actions of a degree,

$$\sin x = .01745\, x \left[1 - \left(\frac{x}{200}\right)^2\right]^2 \qquad (1)$$

mplified, this may be written as:

$$\sin x = \frac{c}{16}(5 - c^2)^2 \qquad (2)$$

where $c = \frac{x}{90}$. If the angle is given in radians $\left(r = \frac{x}{57.3}\right)$.

$$\sin x = r\left[1 - \left(\frac{r}{3.5}\right)^2\right]^2 \qquad (3)$$

Example 1—To find the sine of 62° 12′.

By Eq. (1), ($x =$ 62.2), $\sin x = .885$
By Eq. (2), ($c =$ .691), $\sin x = .884$
By Eq. (3), ($r =$ 1.0856), $\sin x = .886$
(By tables, $\sin x = .8846$)

Taking advantage of the reciprocal symmetry of natural tangents about the unity value for 45°, the following symmetrical formula is obtained:

$$\tan x = \left(\frac{1 - b}{1 + b}\right) \cdot \left(\frac{4.5 + b}{4.5 - b}\right) \qquad (4)$$

where $b = 1 - \frac{x}{45}$. This may be re-written:

$$\tan x = \frac{c}{1 - c} \cdot \left(\frac{11 - 4c}{7 + 4c}\right) \qquad (5)$$

where $c = \frac{x}{90}$. Equations (4) and (5) are accurate within 0.6 percent

Example 2—To find the tangent of 40° 30′.

By Eq. (4), ($b = 0.1$), $\tan x = .855$
By Eq. (5), ($c = .45$), $\tan x = .855$
(By tables, $\tan x = .8541$)

Example 3 — Circular Arcs and Chords: By Eq. (2), with slight modification,

$$\frac{\text{Arc}}{\text{Chord}} = \left(\frac{19.8}{19.8 - c^2}\right)^2$$

for $x = 0$ to 180°, where x is the central angle, and $c = \frac{x}{90}$.

To find the central angle of an arc that is 30 percent longer than its chord:

$$\left(\frac{19.8}{19.8 - c^2}\right)^2 = 1.30 \qquad \therefore c = 1.56$$
$$x = 140^\circ$$

The following simple formula for logarithms will be found to have a wide diversity of practical applications:

$$\log_e (1 + x) = \frac{x}{1 + .45\, x} \qquad (6)$$

This gives results correct within 1 percent for all values of x from 0 to 1. (To find the common logarithm, multiply by .4343).

The power-series expansion of the same function $\log_e (1 + x)$ by Maclaurin's Theorem is too slowly convergent. For the same range and accuracy as Eq. (6), the computation of more than one hundred terms in the power series may be required.

Example 4—To find the natural logarithm of 1.82.

By Eq. (6), $\log_e (1.82) = \frac{.82}{1 + .369} = .5990$

Equation (6) is useful in calculations of compound interest, present worth, annuities, and sinking funds; damping coefficients and logarithmic decrements in vibration and oscillation problems; decibels and similar logarithmic relations of sound and light intensities; logarithmic and exponential functions; hyperbolic and inverse hyperbolic functions; and various problems involving integrations.

Example 5—Exponentials: To find $e^{.39}$.

$$\frac{x}{1 + .45x} = .39, \quad \therefore x = .473$$
$$(1 + x) = 1.473$$

Example 6—Fractional Powers: To find $(1.831)^{\frac{1}{5}}$.

$$\frac{1}{5}\left(\frac{.831}{1 + .45\,(.831)}\right) = .121 = \frac{x}{1 + .45x}$$
$$\therefore x = .128 \qquad (1 + x) = 1.128$$

Example 7—Logarithmic Ratios: To find the value of a decibel ($= 10^{\frac{1}{10}}$).

$$\frac{x}{1 + .45x} = \frac{1}{10}\left(\frac{1}{.4343}\right) \quad \therefore x = .257$$
$$(1 + x) = 1.257$$

Example 8—Damping Coefficients: Given $\delta = .093$, $n = .133$. To find the Logarithmic Decrement λ.

$$\frac{\lambda}{1 + .45\,\lambda} = \frac{n\,\delta}{1 + .45\,\delta} \quad \therefore \lambda = .01187$$

(By logarithms. $\lambda = .0119$—Difficult to get accurate.)

Example 9 — Compound Interest Problems:

Given: $r = 3\frac{1}{2}\%$, $n = 15$ years.

$$\frac{15\ (.035)}{1 + .45\ (.035)} = .517 = \frac{x}{1 + .45\ x}$$

$\therefore x = .674 =$ compound interest

$1 at compound interest $= 1 + x =$ $1.674

Present worth of **$1** $= \frac{1}{1 + x}$ = $ .597

Amount of an annunity of $1 $= \frac{x}{r}$ = $19.25

Sinking fund for **$1** $= \frac{r}{x}$ = $.0519

Present worth of annuity of $1

$= \frac{x}{r\ (1 + x)}$ = $11.50

Annuity from $1 $= \frac{r\ (1 + x)}{x}$ = $.0869

Compound interest to double capital:

$$n = \frac{1 + .45\ r}{1.45r} = 20 \text{ years}$$

The foregoing problems (Examples 6 to 9) are of the "compound interest" type, involving a relation of the form

$$(1 + r)^n = 1 + x$$

To facilitate the direct solution of such problems, Eq. (6) yields the following formula:

$$x = \frac{nr}{1 - .45\ (n - 1)\ r} \qquad (7)$$

Example 10—Compound Interest: To find the interest, compounded semi-annually, on $1 at $3\frac{1}{2}$ percent for 12 yr. ($n = 24$, $r = .0175$).

$$x = \frac{24\ (.0175)}{1 - .45\ (23)\ (.0175)} = .513$$

Amount = $1.513

Example 11—Yield of Bonds: What is the equivalent compound interest yield on bonds purchased at $18.75 and redeemed at $25 in 10 years?

$$\frac{25}{18.75} = 1.333$$

$$.333 = \frac{10\ r}{1 - .45(9)\ r} \qquad \therefore r = 2.94\%$$

Example 12—Powers of Numbers: To calculate $(1.215)^{2.57}$.

$$x = \frac{(2.57)(.215)}{1 - .45(1.57)(.215)} = .651$$

Answer: $(1 + x) = 1.651$

Formulas for logarithms

From Eq. (6), the following additional formulas for logarithms may be written, each accurate within 1 percent for the respective indicated range:

(For $x = 0$ to $\frac{1}{2}$),

$$\log_e (1 - x) = \frac{-x}{1 - .55\ x} \qquad (8)$$

(For $x = \frac{1}{2}$ to 1),

$$\log_e (x) = \frac{x - 1}{.45 + .55\ x} \qquad (9)$$

(For $x = 0$ to 2), $\log_e (1 + x)$

$$= \frac{x}{2 + .45\ x} + \frac{x}{2 + 1.45\ x} \qquad (10)$$

(For $x = 0$ to ∞), $\log_e (1 + x) =$

$$\frac{1}{d + 1} + \frac{1}{d + 2} + \frac{1}{d + 3} + - - - + \frac{1}{d + a} \qquad (11)$$

where $a =$ any integer $\geqq x$, and

$$d = \left(\frac{a}{x} - .55\right)$$

(For $N = 1$ to ∞, and $x = 0$ to 1),

$$\log_e (N + x) = \frac{1}{1.45} + \frac{1}{2.45} + \frac{1}{3.45} + - - - + \frac{1}{(N - 1) + .45} + \frac{x}{N + .45\ x} \qquad (12)$$

Example 13—Logarithm of Any Number: To find $\log_e 4.74$.

By Eq. (11), $x = 3.74$, $a = 4$, $d = .52$

$$\log_e 4.74 = \frac{1}{1.52} + \frac{1}{2.52} + \frac{1}{3.52} + \frac{1}{4.52} = 1.559$$

By Eq. (12), $N = 4$, $x = .74$

$$\log_e 4.74 = \frac{1}{1.45} + \frac{1}{2.45} + \frac{1}{3.45} + \frac{.74}{4 + .333} = 1.558$$

Note: This solution represents the relation:

$$4.74 = \frac{2}{1} \cdot \frac{3}{2} \cdot \frac{4}{3} \cdot \frac{4.74}{4}$$

The solution by Eq. (11) represents the relation:

$$4.74 = \frac{5.07}{1.07} = \frac{2.07}{1.07} \cdot \frac{3.07}{2.07} \cdot \frac{4.07}{3.07} \cdot \frac{5.07}{4.07}$$

From the foregoing equations, corresponding formulas may be written for *common* logarithms:

(For $x = 0$ to 1), $\log_{10} (1 + x)$

$$= \frac{x}{2.32 + x} \qquad (13)$$

(For $N = 1$ to ∞, and $x = 0$ to 1),

$$\log_{10} (N + x) = \frac{3}{10} + \frac{3}{17} + \frac{3}{24} + - - - + \frac{3}{7(N - 1) + 3} + \frac{x}{2.32\,N + x} \qquad (14)$$

Example 14—Common Logarithm of Any Number: To find $\log_{10} 4.74$.

By Eq. (11) or (12)—(See Example 13),

$$\log_{10} 4.74 = .4343\ (1.559) = .677$$

By Eq. (14), $N = 4$, $x = .74$,

$$\log_{10} 4.74 = \frac{3}{10} + \frac{3}{17} + \frac{3}{24} + \frac{.74}{9.28 + .74} = .6753$$

(See Note in Example 13.)

A different series of formulas for logarithms may be built up from the following equation of simpler form but more limited range:

(For $x = 0$ to .4),

$$\log_e (1 + x) = \frac{x}{1 + \frac{x}{2}} \qquad (15)$$

By annexing additional terms, range may be increased:

(For $x = 0$ to 9), $\log_e (1 + x)$

$$= \frac{x}{1 + \frac{x}{2}}\left(1 + \frac{x}{20} - \frac{x^2}{2800}\right)$$

(For $x = 0.1$ to 23), $\log_e (1 + x)$

$$= \frac{x}{1 + \frac{x}{2}}\left(1 + \frac{x}{20} - \frac{(x - 3)^2}{900}\right)$$

(For $x = 0$ to 21), $\log_e (1 + x)$

$$= \frac{x}{1 + \frac{x}{2}}\left(\frac{3}{7} + \frac{x}{41} - \frac{x^2}{2100}\right)$$

(For $x = 1$ to 8),

$$\log_e x = \frac{x - 1}{x + 1}\left(1.89 + \frac{x}{10}\right)$$

(For $x = 1.02$ to 22),

$$\log_e x = \frac{x - 1}{x + 1}\left(\frac{15}{8} + \frac{7}{60}x - \frac{x^2}{450}\right)$$

(For $x = 1.02$ to 22), $\log_{10} x$

$$= .0506\left(\frac{x - 1}{x + 1}\right)(16 + x - .019\,x^2)$$

Formulas for exponentials

From Eq. (6), the following formulas for exponential functions ma be written:

$$\text{(For } x = 0 \text{ to .7)}, \quad e^x = \frac{1 + .55\ x}{1 - .45\ x}$$

$$\text{and} \quad e^{-x} = \frac{1 - .45\ x}{1 + .55\ x}$$

$$\text{(For } x = 0 \text{ to } \infty), \quad e^x = \left(\frac{N + .55\ x}{N - .45\ x}\right)$$

$$\text{and} \quad e^{-x} = \left(\frac{N - .45\ x}{N + .55\ x}\right)$$

where $N =$ any number $\geqq 1.4x$. Th original error of 1 percent is magnified by the power expansion.

A modified form of the precedin equations may be written by usin

$$\text{(For } x = 0 \text{ to .8)}, \quad e^x = \frac{9 + 5\ x}{9 - 4\ x}$$

A greater range is given by th following formula:

(For $x = 0$ to 2.3),

$$e^x = 1 + 1.3\ x\left(\frac{3.15 + x}{4.12 - x}\right)$$

From this, a convenient and accurate working formula of unlimited range may be written, utilizing th powers of 10:

(For $x = 0$ to ∞),

$$e^x = 10^{N + a} = 10^N\left(1 + 3a\,\frac{1.37 + a}{1.79 - a}\right)$$

where $N + a = .4343\ x$, and $a = 0$ to 1

These exponential functions occu frequently in the Deflection Theor for suspension bridges and in othe engineering applications.

Example 15—Exponentials: By Eq. (26):

$$e^{8.294} = 10^{3.602} = 1000\left(1 + 1.806\,\frac{1.97}{1.1}\right) = 3998$$

$$^{4.230} = 10^{4.078} = 10{,}000\left(1 + .234\,\frac{1.448}{1.712}\right)$$
$$= 11{,}980$$

From Eq. (7), we may write:

(For $a = 1$ to 2, and $a^x = 1$ to 2),

$$a^x = 1 + \frac{(a-1)\,x}{1 - .45\,(a-1)\,(x-1)} \qquad (27)$$

Many of the problems previously illustrated (Examples 6, 8, 9, 10, 11, and 12) may be solved directly by this formula.

Formulas for hyperbolic functions

Utilizing any of the formulas for (Equations 22 to 26, inclusive), working formulas for the hyperbolic functions may be written, as follows:

$$\sinh x = \frac{1}{2}\left(b - \frac{1}{b}\right) \qquad (28a)$$

$$\cosh x = \frac{1}{2}\left(b + \frac{1}{b}\right) \qquad (28b)$$

$$\tanh x = \frac{b - \frac{1}{b}}{b + \frac{1}{b}} \qquad (28c)$$

where $b = e^x$. These formulas would have the same range as the corresponding formulas for e^x.

For the full range ordinarily tabulated ($x = 0$ to 5), the following formulas may be used:

$$\frac{\sinh x}{x} = 1 + \frac{x^2}{30}\left(\frac{90 + x^3}{18 - x}\right) \qquad (29)$$

(Maximum error = 0.73%)

$$\frac{\sinh x}{x} = 1 + \frac{x^2}{5}\left(\frac{88 + x^3}{107 - 6x}\right) \qquad (29a)$$

(Maximum error = 0.55%)

$$\cosh x = 1 + \frac{x^2}{2}\left(1 + \frac{x^2}{14 - 1.77x}\right) \qquad (30)$$

(Maximum error = 0.73%)

$$\frac{\tanh x}{x} = \frac{29 + x\,(.8 + x)}{29 + x\,(1 + 10.2\,x)} \qquad (31)$$

Maximum error = 0.53%)

For $x > 5$, use $\tanh x = 1.0000$, and $\cosh x = \sinh x = \frac{1}{2}e^x$.

Catenary formulas

Computations of catenary curves (as in the calculations for the stringing of suspension bridge cables) are among the many engineering applications of hyperbolic functions. The formulas given above enable us to write the equations for the catenary in algebraic form.

If the length L and the span l are given, the parameter c is ordinarily determined by a method of successive approximations from the equation:

$$L = \frac{2}{c}\sinh\frac{cl}{2} \qquad (32)$$

A simple formula for direct determination of the parameter is given by Eq. (29), using only the principal terms:

$$\frac{cl}{2} = \sqrt{6a} \qquad (33)$$

where $a = \frac{L}{l} - 1$. This formula is good up to a sag-ratio of $\frac{1}{6}$ (or $a = 0$ to .08 and $\frac{cl}{2} = 0$ to 0.7). By adding one more term, the range may be increased up to a sag-ratio of $\frac{1}{4}$ (or $a = 0$ to .2, and $\frac{cl}{2} = 0$ to 1):

$$\frac{cl}{2} = \sqrt{6a} - \frac{a}{8} \qquad (33a)$$

Example 16—Catenary Computations: To find the parameter of a catenary in which $\frac{L}{l} = 1.015$. ($a = .015$)

By Eq. (33), $\frac{cl}{2} = \sqrt{.09} = .300$

The equation of the catenary curve is

$$y = \frac{1}{c}\,(\cosh cx - 1) \qquad (34)$$

With the aid of Eq. (30), this may now be written:

$$y = \frac{cx^2}{2}\left(1 + \frac{c^2x^2}{14 - 1.77cx}\right) \qquad (35)$$

Or, using Eqs. (22), (28b), and (34), a simpler formula for the catenary curve may be written:

$$y = \frac{cx^2}{2 + \frac{cx}{5} - \frac{c^2x^2}{2}} \qquad (35a$$

The tension in the catenary at any point is then given by

$$T = w\left(y + \frac{1}{c}\right) \qquad (36)$$

Formulas for circular segments

A useful application of the empirical formulas for sines of angles is in the simplified solution of problems involving circular segments.

Let $S = \frac{\text{area of segment}}{\text{area of circle}}$, and x = the central angle. With the aid of Eq. (2) we may write:

$$(\text{For } x = 0 \text{ to } 90°),\ S = \frac{c^3}{99}\,(10 - c^2) \qquad (37)$$

where $c = \frac{x}{90}$.

(For $x = 90°$ to $180°$).

$$S = \frac{1-c}{2} + \frac{c^3}{99}\,(10 - c^2) \qquad (38)$$

where $c = 2 - \frac{x}{90}$.

Similarly, let $h = \frac{\text{height of segment}}{\text{diameter}}$. With the aid of Eq. (2) we may write:

$$h = \frac{c^2}{1024}\,(160 - 10c^2 + c^3) \qquad (39)$$

where $c = \frac{x}{90}$.

For more direct solution of h or S, when the other is given, use the formula:

$$h^{\frac{3}{2}} = \frac{6S}{10 - 3S} \qquad (40)$$

Example 17—To find the depth of water in a pipe flowing $\frac{3}{4}$ full.

$S = \frac{1}{4}$. By Eq. (38), $c = .529$.
$x = 132.7°$
By Eq. (39), using $c = 1.471$.
$h = .299$
Direct solution:
By Eq. (40), for $S = \frac{1}{4}$.
$h \doteq .297$

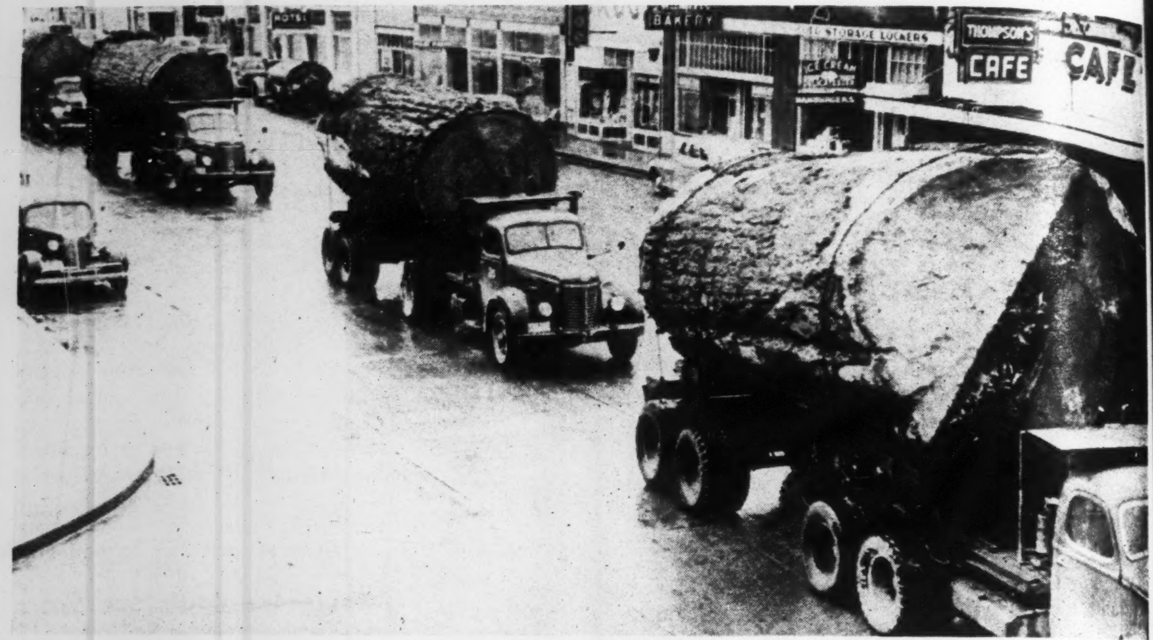
All of the foregoing formulas have useful applications in engineering practice. They have been selected from the writer's list as typical illustrations of a method. By modifications of the coefficients or by annexing additional terms, the accuracy of the formulas may be increased; or by sacrificing accuracy, even greater simplicity of form may be gained.

Removing Moisture from Timber with Solvents

A plant for testing commercial possibilities of a process for extracting oil, resin and moisture from timber by means of solvents is being built by the Western Pine Association in Portland, Ore. The method is a byproduct of experiments on removal of oil and resin from knots to prevent "bleeding" through paint. During these experiments it was discovered that the solvents reduced moisture content to a surprising degree. Then tests with 2½x4x18-in. pieces of green Ponderosa pine showed that the solvents could reduce moisture to about 10 percent leaving the wood much lighter in color than when dried in a kiln. Moreover, specimens treated by solvents did not check and knots lost their oily appearance.

The new process produces an oily resinous extract amounting to 2 to 5 percent of the original weight of the timber treated. This extract is now undergoing analysis in search of values it may have as a byproduct useful in the manufacture of paints, plastics, etc.

A notable characteristic of wood treated by the extraction method is said to be its readiness to absorb liquids such as preservatives, water repellants, fire retardants, and coloring matter or stains. Studies are now being made on the feasibility of a single treatment in which lumber would be dried, protected against decay organisms, given fire resistant qualities and a color treatment.



Press Association, Inc. Photo

Fig. 1. *From these four 10-ton sections of a single Douglas fir tree hundreds of feet of plywood can be produced.*

How Plywood is Produced

Contents in Brief—*Peeled from huge logs of Douglas fir, thin wood ribbons are cut, graded and patched, then glued, assembled and pressed into sheets of various thicknesses. The resulting plywood is finding wide application for girder webs, form liners, wall sheathing and many other wartime uses.*

Out of the Pacific Northwest during 1942 came 1¾ billion sq.ft. of Douglas fir plywood, shipped to all parts of the country and, with our armed forces, to all parts of the world. This laminated lumber product, built up of three or more plies glued together with the grain of alternate layers at right angles, was relatively unknown until a few years ago.

Now it is widely used in building construction, for cabinet work, concrete forms, "plate" girders and scores of other uses. At the same time it has become so indispensable for bomb racks, amphibian wing floats, pontoon bridges, overseas huts and innumerable other wartime uses that a priority classification of AA-1 is required for assured shipment of waterproof grades, while AA-2 is needed for moisture-resistant grades.

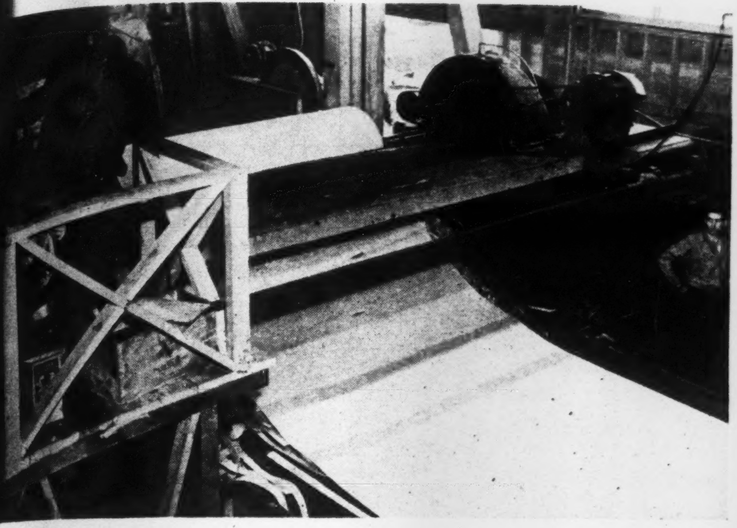
Wartime popularity has brought plywood to the attention of many builders and manufacturers to whom its qualities offer something not to be had in other materials. In such applications this relatively new product has made a place for itself that bespeaks a permanent demand. It can now be said that plywood is a nationally used product whose strength and adaptability to a wide variety of uses are generally known and appreciated. How it is produced is not so widely understood.

Why Douglas fir is used

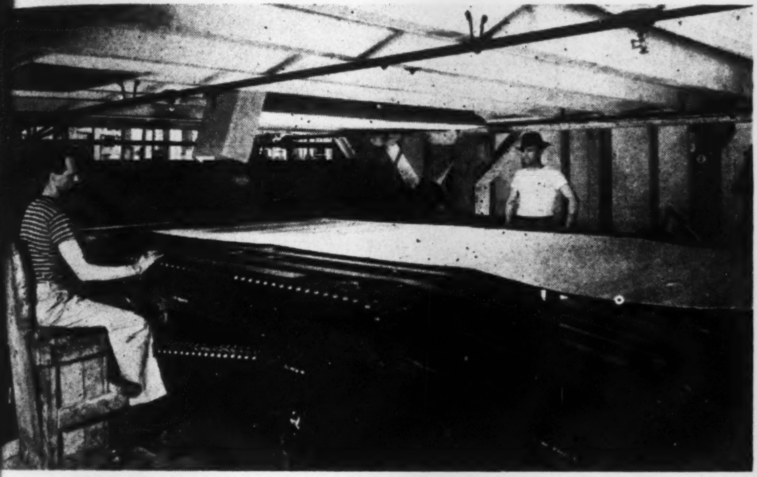
Four reasons make Douglas fir particularly well-adapted to the manufacture of plywood: it is strong, light, straight-grained and has annular rings of very uniform width. Commercially the most important tree in the United States, Douglas fir grows most abundantly on the western slopes of the Cascade Mountains where rich soil, heavy annual rainfall and absence of severe winds favor growth into tall trees whose clear, straight grain admirably meets the requirements for good plywood.

Since plywood requirements are most exacting, a material well suited to its manufacture may not vary even slightly from a uniformly high quality. The manufacturing process begins with the greatest care being used in selection of "peeler" logs, which are chosen for each mill by experts. Peelers now average 3 to 4 ft. in diameter at the small end, must be free from knots and defects of all sorts and the crosscut at the end must indicate a minimum of sap wood and a maximum of clear, soft heart wood. Wartime demand for logs has decreased by about 2 ft. from the 5- to 6-ft. minimum diameters formerly accepted.

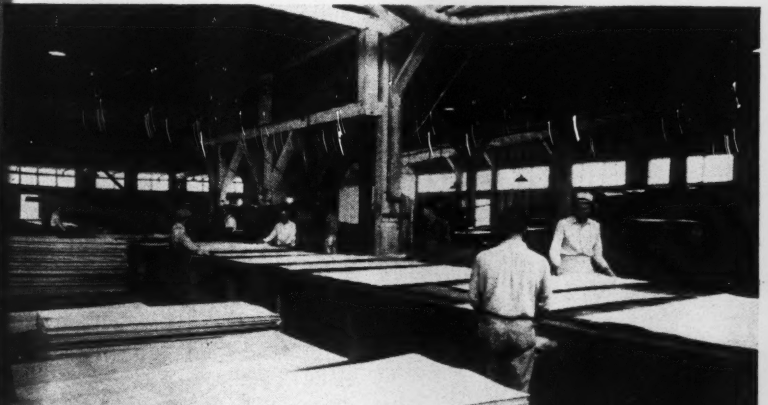
Arriving at the millpond in 30- to 40-ft. lengths, the peeler logs are cut to sizes for the 6-, 8-, 10- or 12-ft. standard length panels. The first mill operation is in the "barker," a claw-like arm that presses against the rapidly rotating log, trimming away the rough outer bark to expose a smooth surface of a truly cylindrical shape ready for the razor-sharp edge of the knife in the lathe.



ig. 2. A giant lathe rotates the knot-free peeler log against a knife sharp nough to shave off a continuous ribbon of veneer.



ig. 3. The clipper man determines the most economical plan of cutting, and ushbuttons at his fingertips set the knives in motion.



ig. 4. The grading conveyor carries unsorted sheets past workmen who select nd pile them according to grade and size.

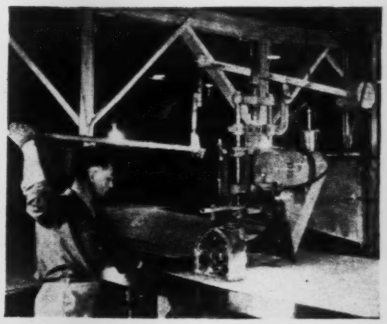


Fig. 5. Defects or blemishes in the sheets are removed by oval cutouts of exactly predetermined standard sizes.

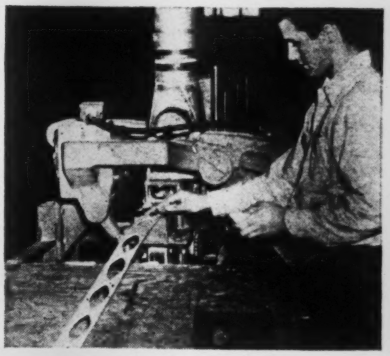


Fig. 6. Oval-shaped patches, made wholesale, will exactly fit the ovals cut out in removing defects.

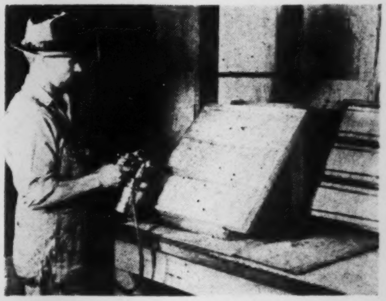


Fig. 7. The patches or inserts are glued only on the edges which are beveled to fit only one way into the sheet being repaired.

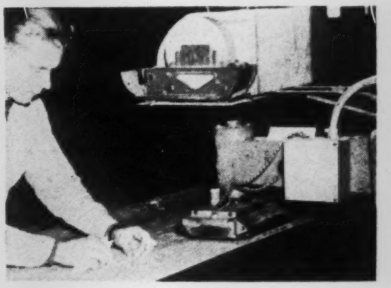


Fig. 8. When the patch is in place a hot press is applied, setting the glue of the insert within a few seconds.

The all-important peeling or unwinding operation is an accurate cutting off of a continuous layer or wood ribbon of veneer, remarkably uniform in thickness. Standard veneer thicknesses are $\frac{1}{7}$-, $\frac{1}{8}$- and $\frac{1}{10}$-in., although veneer as thin as $\frac{1}{16}$ in. and as thick as $\frac{5}{16}$ in. is regularly peeled in the Douglas fir region.

The veneer comes away from the log much as a long sheet of newsprint paper unwinds from its roll. Continuous conveyors carry it from the lathe to storage tables ranged one above the other. When the table o one level is filled, the continuous flo is transferred to another table abov or below. From this storage th sheets move as desired, on a continuous belt past the "clipper man," highly skilled worker at whose fingertips are pushbuttons controlling th guillotine that clips the veneer int the desired sizes. A good clipper ma makes decisions that eliminate defects and cuts the long sheet with minimum waste. The continuous flow of pieces from the clipper is sorted over b workers who select and pile according to width and grade.

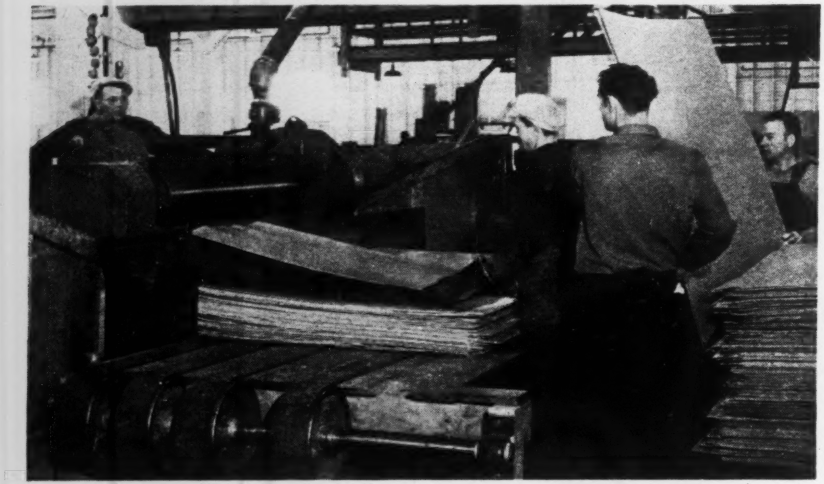


Fig. 9. Glue is put on the plies with a high degree of uniformity by rollers like those used for inking newspaper presses.

Drying ovens, in which temperatures, speed of travel and rate o moisture extraction are very accurately controlled, receive the plies containing perhaps 30 percent moisture, and in 8 to 10 min., depending upon thickness of the ply, deliver a product with a definite moisture content, usually somewhere between 4 and 6 percent. After the drying, mechanical cooling is employed to assist in keeping manufacturing operations continuous.

Flaws are cut out and patched

To avoid waste of otherwise good pieces, minor defects are patched after the flaws have been cut out. The automatic saws that make these cuts are set to remove sections of only certain sizes and shapes. Thus, standard patches can be made wholesale to fit any of the cuts made in removing blemishes. Ordinarily, an endeavor is made to keep the patch sizes to a maximum of two or three. Patches sized to fit perfectly in these standard cuts are impregnated with synthetic resin binder to make them impervious to moisture. When they have been fitted into place by hand a hot iron is placed over the patch, firmly setting the resin and literally welding the patch to the veneer within a few seconds.

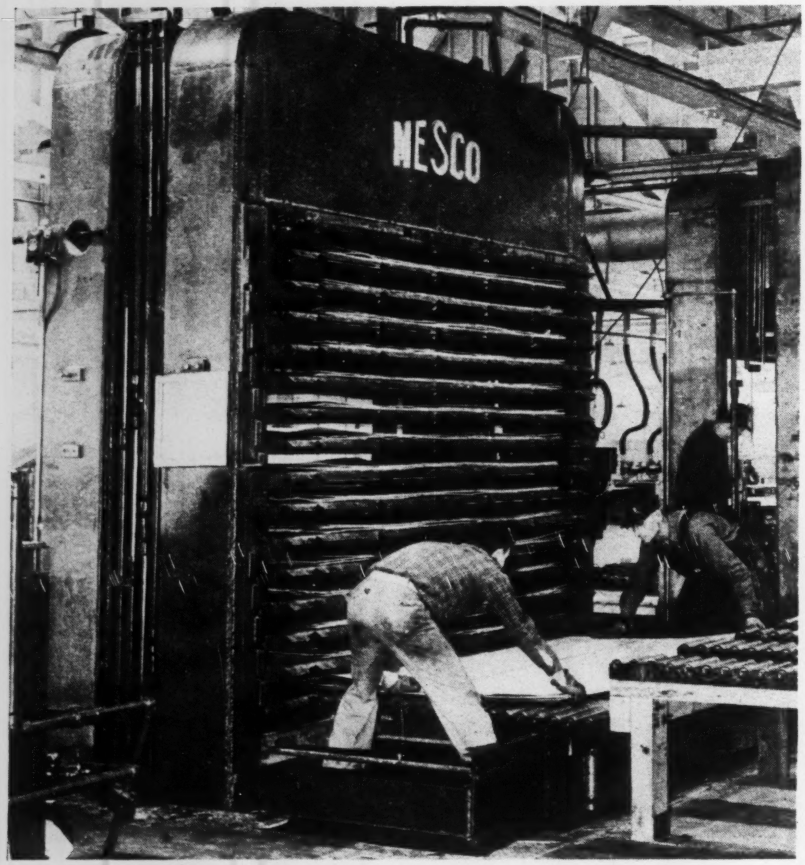


Fig. 10. In hot presses exerting 185 lb. per sq.in. at 230 deg. F., synthetic resin adhesives are set in 4 or 5 min. to form a bond between adjacent plies.

The plies are now ready to be assembled. A power-driven glue spreader comprising two rollers applies a continuous layer of glue of just the right amount so that the glue line of the resulting plywood will have a uniform, maximum strength. The plies are put together in odd numbers (usually 3, 5 or 7 plies to the sheet) with the grain of each ply at right angles to those above and below it. There is no measurable difference in strength between the perfect and the patched plies, but for the sake appearance the unblemished ones e usually placed on the outside sur-es of the finished panel.

Panels glued under pressure

Assembled panels are stacked in a ndle about 3 ft. high which then es into a hydraulic press to be held om 15 min. to an hour, according the type of glue used, under pres-res up to 250 lb. per sq.in. This is e "cold-press" method, using pro-in glues made of such materials as sein and soy beans.

In the hot-press method, used for ywood that must be impervious to ater, the glue is put on the plies in e same way, but a press is used that capable of applying steam heat rough hot-plate layers interspersed the pile, in this way providing heat r setting the glue line of each panel dividually. When phenolic resin ue is used in the hot press a water-oof glue line results. This water-oof quality is proved by tests made samples by subjecting them alter-ately to drying and submergence in iling water.

Removed from the presses, the nels are trimmed and squared to liminate the necessity for any rther shaping on the job, after hich each panel is sanded on both ces, and the product is ready for orage and shipment. For special ses where rough finish is an advan-ge the sanding process is simply mitted.

Five standard grademarks

There are five standard grades of Douglas fir plywood, each of which s grademarked with a stamp on the everse side of every panel. On un-anded sheeting the grademark is cored across the face of the panel n parallel lines 16 in. apart. This marking facilitates the work of the arpenter on the job, since in most tandard construction nailing to the framework of a building follows these ame 16-in guide marks.

The special grade used for form-ng smooth concrete surfaces is oiled nd edge-sealed with a silver-green aint that provides a ready means of dentification for this special grade f plywood.

With the development of synthetic esins that are boil-proof, fungus-proof and waterproof, questions bout durability of plywood now con-ern the wood itself rather than the ond between plies. Moreover, as the glues have been improved, so have methods of application both in the mill and on the job. Tests on plywood glued to studding show strength of bond far exceeding that obtained by nailing.

Plywood panels come cut to exact dimensions, a feature that has permitted their use in mass housing projects with almost no cutting. They are also available in specially made thicknesses of 3 or 4 in., particularly useful for gusset plates in heavy timber structures. Such applications lend credence to the claim that this laminated timber product is destined for an important role in the postwar construction world.

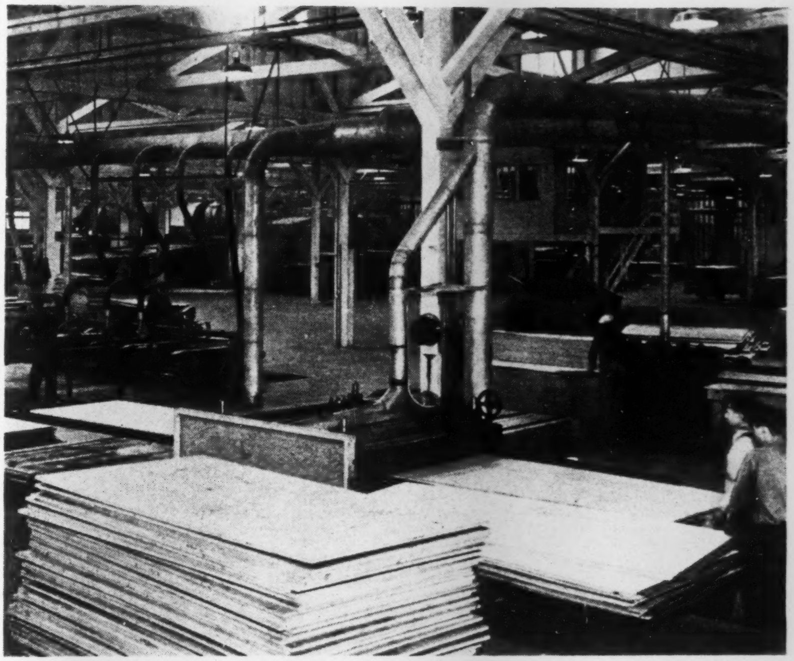


Fig. 11. Trimming saws cut the glued sheets to exact dimensions. Standard panels can be had up up to 16 ft. long and 1 3/16 in. thick.

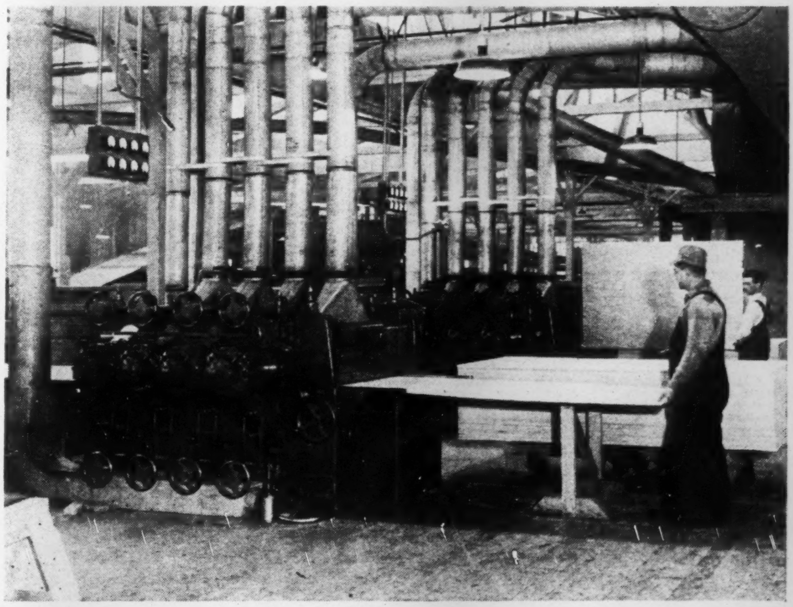


Fig. 12. Power sanding gives a smooth finish to panels before they are grademarked and made ready for shipment from the mill.

Repairs Save Concrete Tank After Settlement Causes Cracks

A THREE-COMPARTMENT Imhoff sewage disposal tank. urgently needed for immediate service at an alien reception center on the West Coast, developed cracks of a destructive nature on first filling. To make it possible to use the damaged structure and to save the time that would have been required to build another, Army engineers devised ingenious means of quickly reinforcing the concrete walls in which cracks had developed. The method of repair involved carefully placed reinforcing steel built up with shotcrete into beams which so strengthened the walls that the tank was available for service in a very short time.

The Imhoff tank consists of three units, each a reinforced concrete box 25x60 ft. in plan, whose depths range from 21 ft. at the ends to 27 ft. at the centers. Because the water table had been found to be 11 ft. below the ground surface, it was decided that the tank should be built with no portion of the foundation more than 6 ft. below ground surface. A general inspection of foundation material at the site resulted in the assumption that a bearing value of 2,000 lb. per sq.ft. could be used. Design was based on this assumption.

Other assumptions were as follows: Minimum strength of the concrete at 28 days, 3,000 lb. per sq.in.; working stresses in the reinforcing, 20,000 lb. per sq.in. Side walls of the compartments were assumed as simply supported at the top beam and fixed at the top of the base section. Side wall beams were assumed to be simply supported at the end walls and fixed at the top of the base section, with continuous support for their full length. Slope of tank bottom and chamfer at the base of the walls are shown in the drawing.

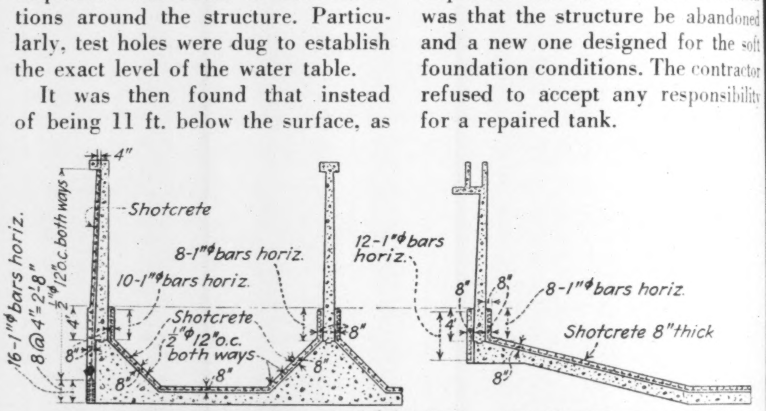
When concrete in the tank, as originally built, had been allowed to set 28 days, filling of the tanks was begun. All three were brought up to the half-full level at which time visual inspection showed no signs of settlement or failure. The end tank was then filled to capacity while the other two remained half full.

The end tank wall, after filling, developed a vertical crack at the center of the wall extending from the foundation up to a point about 8 ft. below the top. Also, two diagonal cracks appeared at the quarter points extending at a 45 deg. angle from the foundation about halfway to the top of the wall. Water escaped in continuous flow from these cracks.

The position of the cracks and the suddenness of the failure suggested that the wall was acting as a simple beam uniformly loaded and supported only at the ends. This led to the conclusion that the foundation at the center of the tank had settled under the load. All tanks were immediately emptied and thorough inspection was made of soil conditions around the structure. Particularly, test holes were dug to establish the exact level of the water table.

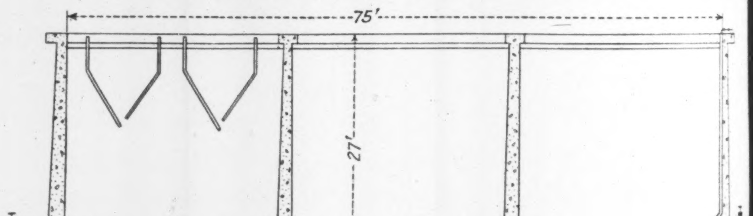
It was then found that instead of being 11 ft. below the surface, as had been expected. the water table had been raised. by the flooding of nearby farmland. until it was 2 ft. above the lowest point of the concrete foundation. Under these conditions of saturation. the bearing value was about 700 lb. per sq.ft. instead of the design assumption of 2,000 lb. This confirmed the theory that the foundation had settled under the center of the tank and that the one side wall had acted as a simple beam supported by the end walls at the two ends. It is to be noted that if full loading of all the tanks had been completed, the structure probably would have failed because of this foundation condition.

Engineers for the contractor reported that because of the tank's "floating" condition, repair would be impracticable. Their recommendation was that the structure be abandoned and a new one designed for the soft foundation conditions. The contractor refused to accept any responsibility for a repaired tank.



Section Through End Wall and Division Wall Section Through Side Wall

TANK SECTIONS AFTER REPAIRS



TANK AS ORIGINALLY BUILT

General arrangement of three-compartment Imhoff tank that cracked, and sections showing location of reinforcing beams and basket lining built up with shotcrete.

Because of the urgency of the ed for this tank, Col. J. D. Andrews ., Corps of Engineers, undertook sponsibility for a drastic program rehabilitation. The plan of re- air was based on experiments with flexible box filled with water which, hile being relatively unstable in its itial condition, can be easily stabil- ed by stiffening its periphery at e bottom. Accordingly, a stiffening eam was designed for the bottom the three compartments, assuming all computations that the tank ould settle considerably but uni- ormly over the entire area.

A stiffening beam was designed for ach side wall, consisting of two sepa- ate portions, one inside and one out- ide each tank. The minimum thick- ess of the added concrete is 8 in. nd the reinforcing is proportioned o the load to be carried. The outer ortion is in a vertical plane, placed gainst the outer wall of the tank. The depth varies from 3 ft. at the enter of the side wall section to 6 t. at the end walls. Reinforcing steel was so arranged that a low center of ravity was secured, and the objective as to put as much of the wall in ompression as possible.

The inner portion of the two-part beam is 4 ft. in depth and is so lo- ated that its bottom edge coincides with the top of the chamfer. Between these two portions of the stiffening beam 2-in. holes, staggered at 18-in. intervals, were put through the wall. Through these holes $\frac{5}{8}$-in. round bars were inserted and hooked, at each side, to the horizontal steel of the stiffening beams.

Two other expedients adopted

Two other expedients to strengthen and stiffen the structure were adopted. On the outside of the wall a mat of steel was extended from the top of the stiffening beam to the top of the tank. The horizontal steel for this mat was hooked 40 diameters around the end wall. This steel consists of $\frac{5}{8}$-in. rods at 12-in. centers. (End walls were not given any additional strengthening except such as resulted from the stiffening beams.) On the inside of each of the three compartments a basket of reinforced concrete was laid up for a shotcrete lining to be 8 in. thick. The reinforcing consists of $\frac{5}{8}$-in. bars spaced 12 in. apart both ways. This basket of steel is doweled into the center section of the stiffening beam.

After placement of this reinforcing, the entire tank was sandblasted and the steel was covered with shotcrete proportioned to give a strength of 5,000 lb. per sq.in. in 28 days. On each portion of the work the shotcrete was applied continuously until completed and was then sprinkled for 14 days. Loading of the tanks was begun when test cylinders of the shotcrete showed a compression value of 5,000 lb. per sq.in. minimum.

All tanks were first loaded to 60 percent of capacity, and when no indication of settlement was found the structure was left for a 12-hr. period and then another level check was made. This time it was found that the entire structure had gone down uniformly 0.07 ft. This settlement caused the center plug discharge valve to crack which necessitated the dewatering of this tank while a new valve was installed. During this operation, the outer tanks were left at 60 percent of capacity, and before the center tank was reloaded level readings were again taken. These levels showed no further settlement.

Level readings were then taken at intervals of a few hours at the start, and were continued at longer intervals when the tank showed no abnormal behavior. Up to 500 hr. the settlement continued slowly but very uniformly without the development of any cracks. At the ten points where level readings were made, after the 500-hr. period the maximum settlement was 0.282 ft. and the minimum was 0.235 ft. At only two of the ten points did the difference in settlement exceed 0.017 ft.

Hairline cracks appeared at various places on the walls, and although some were damp none permitted a flow of water to escape. Inspections made after a period of several weeks showed that these fine cracks were sealing up, apparently by autogenous healing. From the graph of the average settlement, it was believed that a point of equilibrium had been reached after a period of three weeks.

In a report on the success of this repair job, the U. S. Engineer Department findings were: "The absence of any failure would indicate that the stiffening beam method of rehabilitation is quite practical and could be used on similar structures for unstable foundation conditions."

Highway Traffic Cut 48 percent In 1942 Due to War Restrictions

Reductions of 36 to 60 percent in the volume of traffic on the rural highway system have resulted from the increasing shortages of tires, gasoline and replacement parts, as well as the halt in production of motor vehicles, together with general restrictions on travel. During the second half of 1942, traffic on these roads declined from that of the same period in 1941 by an average of 42 percent in the area under fuel rationing and 23 percent in the unrationed area. This finding of the Public Roads Administration is based on the figures of more than 500 automatic traffic-recording instruments placed throughout the country. With gasoline rationing extended to the entire country in December, the records for that month from 43 states show a decline from December, 1941, of 48.9 percent in the former "rationed" area and 47.6 percent in the former "unrationed" area, with an average of 48.1 percent for the 43 states. The December figures for the several states show a maximum decline of 58.6 percent in West Virginia and a minimum of 36 percent in Utah.

On local roads alone, the decline has been less than on rural highways in general, averaging 35.1 percent for December. Of 15 states, having 120 to 1,000 car vehicles daily on their local roads, the maximum reduction on these roads was 60.6 percent in Michigan, and the minimum was 18 percent, in Georgia. Traffic on toll roads declined much less than on the rural highway system, due in part to the much larger proportion of urban or industrial traffic using these roads as compared to that passing recording stations on the rural roads. On a few toll roads there were greater volumes of traffic than in December, 1941. At 22 such toll facilities, December decline averaged 31.2 percent.

A City Struggles With Garbage Disposal

Contents in Brief—*Seeking a solution for garbage disposal problems, Oakland, Calif., has tried numerous methods that had to be abandoned. For four years an endeavor has been made to satisfactorily operate a disposal plant designed to burn garbage in a kiln after salvage by hand-sorting from a belt. Present program includes disposal of wet garbage to hogs and dry garbage to fill.*

HOW TO DISPOSE of the city's garbage, now totalling some 350 tons per day, has been a vexing question before officials of Oakland, Calif., for four decades. Even now no completely satisfactory plan has been developed. However, much experience has been gained and there are helpful hints and warnings in Oakland's exploration of the problem thus far.

Of all the methods tried, the outstanding "experiment" is the mechanical reduction plant that has been used, in part, for the past four years. During this time city officials have waited hopefully while the contracting scavenger company has tried to work out a practical solution to operating difficulties in a plant said to have cost $100,000 and designed to mechanically handle the garbage, making use of hand-sorting on a salvage conveyor and final disposal by burning in a kiln fired with fuel oil. Methods and equipment used in this experimental plant are described and its present status is reported in the following outline of Oakland's struggle with the garbage problem.

Nearly 40 years ago the first efforts at drying and burning the city's garbage were made using concrete ovens. That plan was abandoned after being used about a year. Garbage was dumped on tide flats until odors and flies got too bad. A cover of dredged material pumped over the tide flat fill was used for a while and in May, 1908, an ocean-going freight steamer was equipped with hoppers above deck and put on a regular schedule of a trip every other day out through the Golden Gate where the load was dumped at sea, presumably in a location whence ocean currents would prevent its return to shore. (At the start the distance out was "10 mi. from shore." Later this was increased to 20 and then 25 mi. from the nearest headland. A state law, passed in 1912, requires sea disposal of garbage to be not less than 20 mi. from the nearest headland.)

The garbage steamer was wrecked in January, 1916, and there was resort to landfill disposal methods until October, 1925, when sea dumping was resumed, this time with two steamers so that one could always be at the dock where scavengers' trucks could discharge their loads (*ENR*, Feb. 4, 1926, p. 194). Despite protests about refuse on beaches of the San Francisco peninsula and the difficulty when winter storms were severe, or fog was dense, of getting the top-heavy steamers out through the Golden Gate and across rough coastal waters, ocean dumping was continued until July, 1942.

Meantime, attention was constantly being given to supplementary disposal methods in the endeavor to be prepared for emergencies. These always met with difficulties—smoke, odors, flies or rats or too high a cost for fuel or for the hauling of earth cover. In short, under conditions obtaining at Oakland, no successful, sanitary and economical plan for burning or fill disposal has ever been developed.

Until 1927 hog raisers were allowed to buy wet garbage (swill) as they pleased. In that year a franchise was granted E. P. Mayer to collect all wet garbage from premises producing more than 50 gal. per week. This stopped independent wet garbage collection and brought the revenue to the city from the payments Mayer was required to make. A minimum price per ton was stipulated plus a sliding scale tonnage rate based on the market price of pork. Fitted to this franchise was a city ordinance

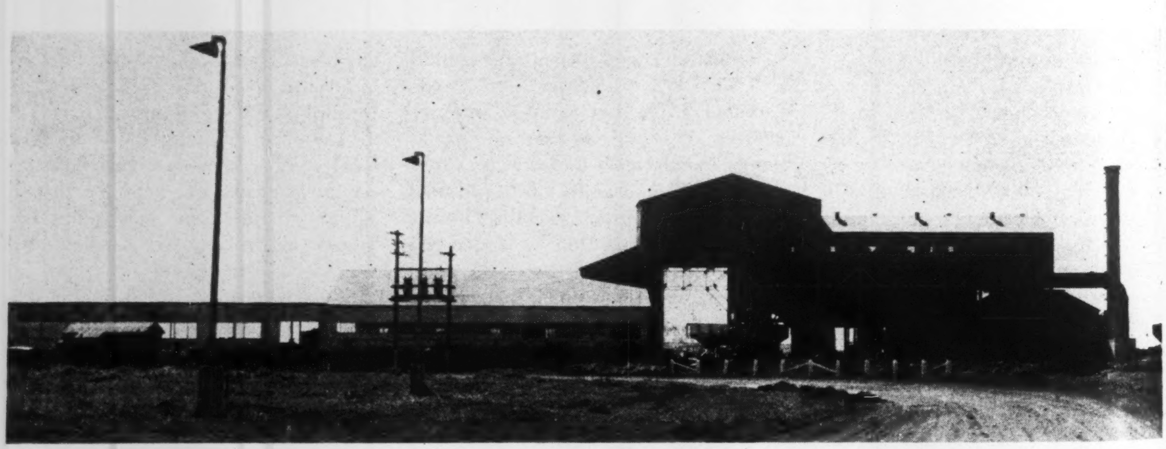


Fig. 1. General view of the mechanical reduction plant. At extreme left is housed the dumping floor from which a belt elevates all material to a 60-in. x 80-ft. belt under which there are hoppers for salvage storage. The kiln is at the right.

ll effective, requiring separate cans r (a) "wet" garbage, to contain ly what can be used for hog food, om premises that produce more an 50 gal. per week and (b) "dry" rbage, which may include other aste materials.

In October, 1932, before the Mayer anchise expired, a joint agreement as reached whereby all the city's ntracts and franchises affecting gar- ge were consolidated into one blan- t contract covering collection and sposal of both wet and dry garbage. his was made with the Oakland Scav- gers Co., which had bought out the ean disposal contractors and thus d disposal as well as collecting op- ations under way. This contract, st intended to run for 12 years, as revised and extended in Decem- r, 1941, to permit substitution of her methods of disposal for the ean dumping and to continue the rm of the agreement to 1957. Op- ation is now being carried out der this contract.

Present procedure

The average of 340 tons of dry rbage collected daily under this ntract comes from an estimated opulation of 360,000 in Oakland lus some 20,000 (estimated) more in iedmont and El Cerrito, a total of bout 380,000. Thus the average runs bout 1,120 people per ton of dry arbage. From Oakland's 360,000 e wet garbage averages about 600 ons per month. Wet garbage is col- cted by an entirely separate fleet of vered trucks ranging in size up to -ton capacity, that go direct to the og farms.

In 1938 O.S.C. built an extensive though experimental) mechanical andling plant to which is trucked ll the city's dry garbage. The orig- nal plan was to here segregate sal- ageable materials and to dispose of he remainder by burning in a kiln red with fuel oil. This plant has een used intermittently since its con- ruction and a part of it, stopping hort of the kiln, is now operated nough of the time to handle a little ore than half of the garbage, it is stimated. The equipment for load- g the main belt conveyor has been ntirely reconstructed and numerous ther changes have been made but, espite greatly increased daily gar- age collections, the additional dis- osal units originally proposed have ot been added.

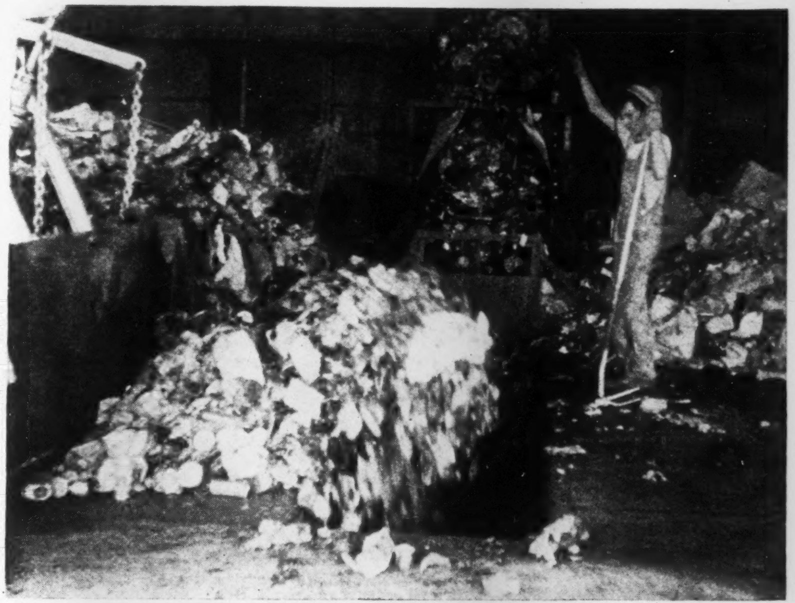


Fig. 2. On the concrete receiving floor a bulldozer (at left) shoves garbage into a slot whence it is conveyed upward into the the plant on a belt. Note gate at end of trench that limits the load reaching the belt.

A major difficulty with the plant as originally built was the tendency of the refuse to cling together and pack down in the receiving hopper in such a way that it could not be moved by gravity. Original design provided for the scavengers' trucks to dump into a hopper whence garbage was to be lifted in a bucket elevator, discharging on a screen ahead of the sorting belt.

The receiving hopper, however, gave trouble from the start. Despite every effort and all modifications, it tended to clog and when once the garbage became packed the only remedy seemed to be piecemeal removal. After 48 hr. in the hopper the tendency was to form "a pulpy mass" that defied equipment handling nor would it "flow" regardless of any of the persuasives employed.

With several successive developments, however, the method of getting the garbage from trucks to the elevated sorting belt has progressed to a successful plan. This is illustrated, in part, in the accompanying picture. The essential change was in doing away with a receiving hopper and substituting a concrete floor. Now there is no need for any accumulation of fresh, unsorted garbage anywhere except on the concrete floor of the charging room where the piles dumped from the scavengers' trucks are handled only by a bulldozer blade. This floor, with its recent addition, is about 80 x 150 ft. in size and is housed in on three sides with galvanized iron.

Garbage dumped on this floor is shoved forward by a bulldozer to a narrow slot in the center beneath which a continuous belt moves horizontally toward the plant. The operator on the floor signals to the man on the bulldozer, thus controlling the advance of the material into the slot and preventing the accumulation there of any excess. At the discharge end of the horizontal portion of the belt a vertical steel plate at an adjustable distance above the belt serves as a gate to strike off and hold back any overload, thus making sure that an inclined belt, conveying from the floor up into the plant, starts with a limited charge.

As will be noted from the picture, this charging method can be controlled in such a way that the belt goes out with a very heavy load. Close attention by a good operator will keep it in this condition as long as the trucks can possibly supply a capacity load.

Under this method of loading and elevating, if there is a little delay by reason of breakdown in the plant or for some other cause, the constantly accumulating collection of refuse merely stands on the concrete floor and, unlike the abandoned hopper method, any compaction that takes place there does not prevent its being handled in the usual manner when operation is resumed. The intent in the design, however, is to keep the entire plant in continuous operation so long as garbage is being adequately delivered.

Since this picture was made, the horizontal portion of the belt has been increased by an extension consisting of a steel-plate conveyor set in a slot only about a foot deep. This shallow depth to a great extent automatically limits the load and simplifies belt-loading operations. The bulldozer ordinarily delivers only to the shallow belt whose speed of travel can be controlled, separately from the main belt, by controls at the gate where the incline starts.

Mechanical equipment

As to mechanical features of the plant itself, the following is an abstract from a statement by the equipment manufacturer:

"The incoming garbage, at the high level, first moves over a screen where material that will pass through ¾-in. openings is screened out. (Much of this is earth and other fines that can be used for fill cover.) Beyond the screen garbage drops onto a picking belt 60 in. wide where, for a length of 80 ft., garbage handlers standing on each side, pick off reclaimable materials. This picking belt has variable speed control. Beneath it is a series of bins each to receive only one kind of salvage.

"The belt discharges through a feed spout into a 60x50-ft. rotary kiln operated by a 15-hp. motor. The kiln has three angle-iron lifters designed to break up the garbage and drop it through hot gases passing through the kiln in a direction opposite to the movement of garbage. Combustion begins in the last 5 ft. of the kiln.

"Discharge from the kiln is to a 5x12-ft. chain-grate stoker over which there is a forced draft induced by a blower. Twin oil burners inject fuel and air into the combustion chamber which encloses the stoker, and an oil pump and fan supply fuel and air for combustion. The function of this chamber is to reduce material discharged from the kiln to ash, which is delivered over a conveyor into piles whence it may be trucked to the fill.

"Gases from the kiln are drawn off by induced draft and delivered to a water scrubber where the gas temperature is reduced from about 600 to not more than 220 deg. F. Chemicals are also added to depress the odors from fatty acids. Hot gases produced in the combustion chamber over the chain-grate stoker are fed into the receiving end of the rotary kiln to aid in drying out the garbage therein.

"The amount of oil required for complete combustion of the garbage has varied from 3 to 4 gal. of oil per ton of garbage fed. Variation is due to the considerable range in moisture content of the garbage. The average content is 65 percent, ranging higher when fresh fruit and vegetable wastes have affected moisture content. The fuel oil used has a heating value of about 18,500 B.t.u. per pound.

"In the additional unit, which it is proposed to construct, the plan is to make the kiln 8 ft. in diameter (2 ft. larger than the one installed) in order to decrease gas velocities and to prevent the entrainment of considerable quantities of fly ash.

"M. Manoc, consulting engineer, designed parts of the garbage disposal plant; the mechanical equipment was furnished by the Allis-Chalmers Co."

Despite the apparently simple process of kiln burning, as just outlined, this part of the plant is reported never to have been operated for long. Of late no endeavor has been made to use the kiln at all. Whether this is the result of insufficient capacity, unobtainable parts, clogging of the mechanism, shortage of operators or merely preference of the contractors for the cheaper and simpler method of dumping on the fill is not known. However, the long belt is used for salvage sorting, usually about 8 hr. per day, which is enough to put through something more than half the tonnage delivered to the plant. The remainder of the tonnage, together with what is discharged from the belt, is trucked out on the adjacent fill and dumped.

Sorting and salvage

Before the labor shortage became acute a "picker" on each garbage truck segregated bottles, metals and some rags. These were handed down, in containers, to the receiving floor in the plant, before the truck dumped. Now that pickers no longer ride the trucks because labor is scarce, some sorting has to be done on the concrete floor, chiefly for bottles and large objects that could not go up the belt.

Along the 80-ft. sorting belt, walkways give access to both sides and workers, stationed at intervals, are on the watch for the kind of salvage to be dropped into the bin below. There are nine bins, not all in use, which have hopper bottoms. Contents of each bin can be released by a gate that allows it to fall by gravity into a truck below.

The five principal salvage items are rags, metals, glass, tin cans and paper. White and colored glass are kept separate but there is a market for all broken glass. Glass and metal are trucked from the hoppers to stockpiles nearby. Tin cans are trucked to gondola cars on a nearby siding where an elevated ramp makes it possible to use gravity delivery from the trucks and rags and paper are securely baled.

Fill disposal methods

The screen ahead of the sorting belt would provide enough earth and other "fines," it is believed, for a 6-in. cover over the fill if all of the dry garbage coming to the plant (an average of 340 tons per day, 6 days per week) were put through the screen and over the belt. Shortage of labor, however, has been such that the belt ordinarily can be operated only one 8-hr. shift. Thus, nearly half the tonnage goes directly to the fill in the dump trucks.

This fill has been carried out toward the bay on an upgrade until the face of the fill, several hundred feet in width, is about 30 ft. high. Enough earth cover is trucked in to make roadways but cover material is not put over the face of the fill. Trucks dump as near the edge as they can safely go and from then a bulldozer shoves the material over the edge. Under compression by the bulldozer and the trucks the material has thus far packed down to a solidity that supports heavy loads. Trucks with gross weights up to 11 tons are regularly delivering to the bulldozer on this fill.

Under the city's contract with O.S.C. this fill must be satisfactory to the city manager. However, with no residences in this area, thus far there has been no serious objection raised by the city authorities to this method of disposal.

Admittedly there is a lively rat population on such a fill. To the question as to whether the rats might migrate to become a nuisance elsewhere, there is the logical reply "Why should a rat ever leave that place?"

Sewer Inspectors Crawl

A "tunnel crawling test" was recently given candidates for the position of sewer inspector by the Milwaukee City Service Commission. Each of 100 applicants was required to descend 16 ft. into the city sewer system and crawl through it for a distance of 327 ft., according to information received by the Civil Service Assembly of the United States and Canada.

Texas Pipeline Transplanted in Florida

***Contents in Brief**—Uncovered by a trencher with blades shaped to cut to the top and sides of the pipe, 194 miles of pipeline was taken up in Texas and relaid across northern Florida. Nearly all of the pipe was reusable after cleaning and straightening. Barges on the Gulf Intracoastal Waterway deliver Texas gasoline to the pipeline for pumping to Jacksonville.*

A PIPELINE of 8-in. diameter, no longer essential for handling crude-oil in Texas, was moved bodily to a new location across northern Florida where it is carrying gasoline to augment rail and tanker deliveries to the East Coast. The pipe was dug up, pumps and pumping plants dismantled, operators' houses and the telephone line (including even the poles) taken down and all moved more than 600 miles eastward to join the war effort. Even those moving the line and those who supervise its operation are Texans.

This work was done to get gasoline from the Texas fields to Jacksonville, Fla., without the use of tankers. Instead of using a sea route, the gasoline is transported by barge along the Intracoastal Canal from Houston to the terminus of the canal at Carrabelle, Fla. Here it is unloaded, transferred to the pipeline and pumped 198.3 miles to an east coast deep-water terminal at Jacksonville. From this point the fluid is distributed to the immediate area by truck or re-loaded on barges for transport north along the Atlantic Intracoastal Waterway and south on the St. Johns River.

The pipe line was originally used in the East Texas oilfield to carry crude oil from Kilgore to a point on the Houston Ship Canal. Loss of tankers has reduced the volume of oil that can be handled from the Texas field and this 194-mi. line became non-essential. The Defense Plant Corporation, through the Petroleum Administration for War. purchased the line from the American-Liberty Pipe Line Co. and arranged for its installation in Florida.

About 94 miles of the pipe was originally laid in 1933 and 1934, and the rest in 1936. The pipe is all nominal 8-in. dia. with that formerly used near the pumping stations (where pressure was highest) $8\frac{5}{8}$ in. o.d. with $\frac{5}{16}$-in. walls and weighing 24.5 lb. per lin. ft. About half the pipe has a thinner wall section weighing 19.5 lb. per ft. All of it is ordinary lap-welded steel pipe with a minimum factor of safety of four against the pumping pressure.

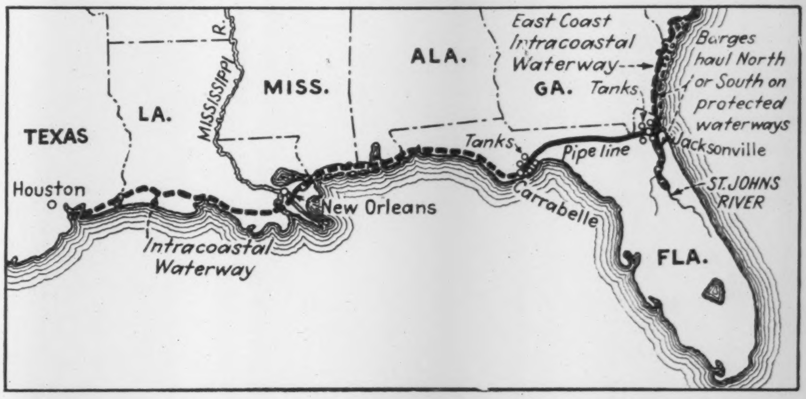
All of the joints were originally arc-welded, those on the first section being made by laying the pipe on rollers and turning it slowly as the bead was run on. For the rest of the line, stovepiping or sticking the pieces on the end of the line one after the other as the work progressed, with a "stringer-bead" placed to hold the pipe temporarily, was used.

None of the pipe originally was given an exterior coating of any kind as the soil through which it was laid was not corrosive. The line was laid on a "speculative shoestring" with the expectation of getting a quick return of investment from the fast developing oil field and neither time nor money were spent on refinements. The original line was laid in rolling country requiring frequent horizontal and vertical bends. A 24-in. cover of earth was over the pipe in its original location.

After being buried for several years the pipe was easily uncovered by a regular trenching machine equipped with blades shaped to cut the dirt away from top and sides. A side-boom crawler crane lifted the pipe from the trench sufficiently to permit sliding timbers under it to hold the line a foot or more above the ground. Special oxyacetylene rigs cut the pipe, using two torches set so that the edge at each side of the cut had a 37 deg. bevel. The pipe line was cut in 40-ft. random lengths for rail transport and 50-ft. sections for that which could be moved on barges on the Intracoastal Canal: cuts were made at points other than the original welds. The sections were loaded on trucks, by a power take-off operated winch and gin pole, for transport to rail or barge.

Salvaged pipe was carefully cleaned by machine and inspected visually before shipping. All bent pieces were straightened in rolls so that when shipped, it was in readily usable condition. Pits more than ¼ the thickness of the pipe wall or noticeable dents or kinks were cause for rejection.

Isolated pits in the pipe were filled by arc welding to permit salvage of slightly damaged sections. Bad areas were cut out where practicable to salvage the remainder of a length. Only a small portion of the line could not be reused as actually 191 miles of the original 194 were relaid.



Pipeline across Florida pinch-hits for canal to connect Gulf and East Coast Intracostal Waterways for transport of gasoline on protected route.

Du Pont Photo

Three rows of 1¼ x 8-in. cartridges of ditching dynamite were tied to a sisal rope that was dragged across the hard lime rock bottom of the Suwanee River to blast a trench for the pipeline.

The pipe not reusable was rusted and pitted sections that had been laid through areas where some electrolytic action had taken place and where alternately wet and dry conditions had caused deterioration. Pipe was also lost at river crossings and at road intersections that had been hard-surfaced after the pipe was laid.

The new line

In its new position the line crosses the relatively flat lands of northern Florida with a maximum rise in the line to 165 ft. above sea level. The route passes through 80 percent timber land, part of which is swamp that required waist deep wading for survey during the summer but was generally passable for equipment by the time actual laying was underway, due to a protracted dry period.

An easement for a 30-ft. wide right-of-way was taken along the entire line, the usual price being 25c. per linear rod plus an allowance for crops or standing timber damaged. The owner retains full use of the land, but the pipeline operators have right of entry for inspection and repair. Damage to crops on re-entry is paid for separately. Little difficulty was experienced in securing easements, despite this being the first such line in the area, as the nature of the emergency was carefully explained to all owners. Right of eminent domain and condemnation was available, but it was necessary to exercise it only in a very few instances to secure passage.

First operation in the field was clearing the right-of-way for the full 30 ft. Useful timber was given back to the original owner and the rest stacked and burned. Trench excavation, through all material except rock at some river crossings, was done by self-powered, crawler-mounted trenchers excavating a trench 20 in. wide and 36 to 40 in. deep with the spoil piled on one side of the trench.

There are seven river crossings on the line. The Suwanee River crossing required trench blasting for the pipeline through the banks and across the bed and the Ochokonee River crossing required some blasting on the approaches but not in the channel. The other crossings and practically all of the balance of the line are free of rock.

Pipe was unloaded from the cars by a gin pole on the back of a truck, operated by a power take-off winch, and hauled out along the line by trailer trucks. It was rolled off the truck in single pieces to string it along the line. Ends of the pipe, previously bevel cut, were smoothed and brightened with a file and each length was cleared inside by drawing a swab through it. No other treatment was given the used pipe before welding.

The pipe was laid by the "stovepipe" method, a single side-boom tractor being used for handling the pipe. A new section was brought to end contact with the ever-advancing pipe and held in line by a rapid-acting clamp over the joint while two welders put on the first bead of a three-bead weld with a $\frac{5}{32}$-in. dia. welding rod. The pipe was laid on timbers near, but not quite over, the pipe trench. Following this operation two 2-man welding teams put on the second and third beads of the weld with a $\frac{3}{16}$-in. dia. rod.

Cleaning and coating

A cleaning machine with rollers and brushes to break up and remove any scale or rust followed the welders. This machine was self-propelled and moved continuously along the pipe, a side-boom crawler-tractor lifting the pipe above the supports in a roller-cradle.

A priming coat was placed on the line by a painting device drawn along the pipe by the cleaning machine. Finally, a hot bituminous enamel, about $\frac{1}{16}$ in. thick, was placed on the pipe by a machine that coated the entire pipe. A quick hardening coal tar with mica filler, which did not require wrapping with either paper or burlap, was used.

As this last operation went on, the timber skids, placed under the pipe to keep it out of the trench, were withdrawn and the pipe allowed to go into the ground. "Slack-loops," for thermal expansion, were left in the line at the rate of four per mile. These were made by leaving the pipe up on a timber to insure a high spot. Backfilling was done with an angle-dozer on a big tractor, after which the timber was removed from under the slack-loops to permit movement.

Pumping operations

There were seven pumping stations on the original line, each with two centrifugal pumps driven at 3,600 rpm. Three of the stations were powered by electric motors and the others by diesels, burning crude oil. The stations originally had different volumes to pump, due to crude entering along the line, and thus the pumps varied in capacity. To get full efficiency from the pumps the distance between them varies from 24 to 35 mi. to use all of the available power and permit each motor to handle a proper share of the work. The electric driven pumps are operated at constant speed and the diesel driven ones work through speed reducers to synchronize the flow. The electric pumps are located at points where adequate outside power is available and the prime-movers burn No. 2 diesel oil.

Capacity of the 8-in. line, with the pumping system described, is about 30,000 bbl. daily and a peak of

4.000 bbl. The pumps are all di-ectly connected to the line with feed successive pumps at about 20 psi. n the suction side. Maximum pres-ure on the line is about 800 psi. Emergency storage tanks of 5.000 bl. capacity are provided at each ump station and can be used for apping the line to provide an inter-ediate distribution point if desired.

Steel storage tanks were purchased ith the line and transported to the Carrabelle terminal. These hold 30.000 bbl. of gasoline or about 10 ays capacity for the pumps. Riveted anks, one with capacity of 80.000 bl., two of 55,000 bbl., and two of 7.500 bbl. are in use as well as sev-ral lap welded tanks of 25 and 0.000 bbl. capacity. To dismantle he tanks the rivets were cut off by a power cold-chisel and the same size rivets redriven in assembly. The lap-elded tanks lost some capacity in the change, as it was necessary to cut out the laps to reassemble. It was originally intended that tanks would be moved to Jacksonville as well but existing storage was found available on deep water on the St. Johns River.

The total cost of the transferred line is about $3.250.000, estimated to be at least one-fourth more than an all new line would have cost if material could have been made available. Even with the line in place it is not expected that it will be able to compete economically with sea-going tankers for delivery to the east coast when conditions become normal. However, as a war measure it will deliver much needed gasoline at Jacksonville and it is probable that the line can be later operated to deliver to inland points in northern Florida and for truck haul into southern Georgia.

The line was built and is being operated by the Trans-Florida Pipeline Corp., a subsidiary of the American Liberty Pipe Line Co. of Dallas, Texas. F. M. Coker is superintendent in charge with offices at Tallahassee, Fla. Actual construction of the line was carried out under fixed price contracts, which were let by the Trans-Florida Corp. for the Defense Plant Corp. Fredell Pipe Line Constructors of Houston, removed half the line and loaded it for moving. Anderson Bros. Construction Co. of Little Rock, Ark., with C. C. Anderson in charge, dug up the other half and re-laid all of the 194 miles in Florida.

The Trans-Florida Pipeline Corp. did the engineering work, supervised the removal and relaying for the D.P.C. at actual cost. Their remuneration for this work was in the sale to the government of the line and in the continuing operation contract.

How to Design Stabilized Soil Mixtures

R. G. Hennes
Associate Professor of Civil Engineering
University of Washington, Seattle, Wash.

DESIGN OF STABILIZED SOIL mixes for airport and highway construction can be both rapid and straight forward by a method used by the writer. The procedure also takes into account both plasticity and grading to a greater extent than do ordinary empirical rules or charts.

In using the method two common assumptions must be made: (1) That the plasticity index of a soil mix is proportional to the clay content of the fraction passing No. 40 sieve, and (2) that the grading of an ideal mix can be expressed by the Talbot equation $P/100 = (d/D)^n$, where P is the percentage by dry weight of particles of diameter less than d millimeters, D is the maximum grain diameter in millimeters, and n is an abstract number. On this basis the ideal grading curve will become a straight line when plotted on logarithmic paper. The first assumption serves to fix the required amount of clay, and the second fixes the ideal grading for the use of that clay in a mix of specified maximum size.

The design of a stabilized mix can be made in four steps. These are:

1. Determine C, the required percentage of clay-size particles in the "through-40" fraction of the final mix, to give the specified plasticity index represented as I in the equation $C = \frac{cI}{i}$. In this formula c is the percentage of clay in the available

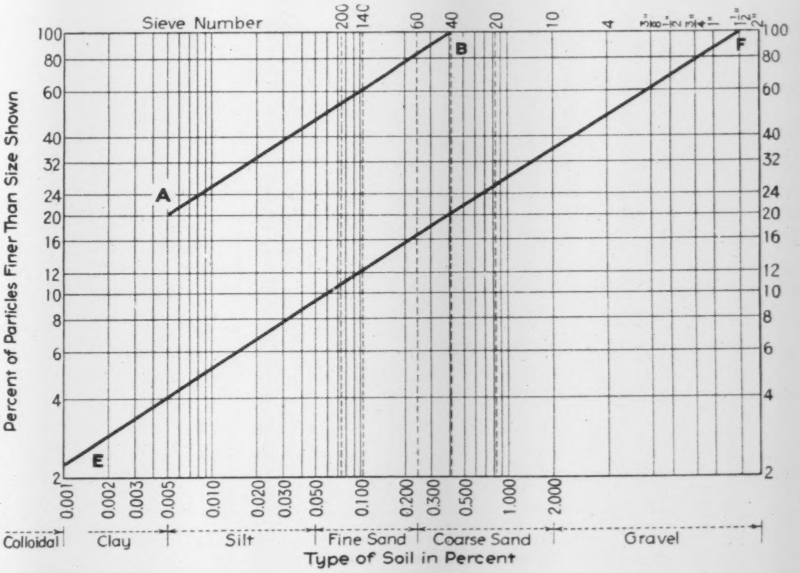


Fig. 1. By means of known data Line AB on the chart above is drawn. Next construction of Line EF, which is explained in detail in text, determines the amount of clay to be added to provide a stabilized mixture.

binder soil (i.e., in that fraction of the binder passing No. 40 sieve), and i is the plasticity index of the binder.

2. With the values obtained from the above operation plot the point on the next graph (Fig. 1), for $y = C$ when $x = 0.005$ millimeters. Next draw a straight line between this point and the Point $y = 100$ when $x =$ No. 40 sieve size, which gives line AB in Fig. 1.

3. Draw a second straight line, parallel to Line AB and passing through the Point $y = 100$ when $x = D$, which gives Line EF in Fig. 1. This latter line is the ideal grading curve for the given materials. The ordinate at the value $x = 0.005$ gives the value C' or the percentage of clay required in the stabilized mix.

4. Determine by the equation $P = (C'/c)\ (100)$ the percentage of binder soil required.

The above computations are all expressed in terms of dryweights, and for field use proportioning is usually done on the basis of loose volumes or truck-loads. Thus, for convenience it is advisable to compact a trial mixture in the laboratory to determine its dry weight per square yard, and to measure the dry weight of binder soil per cubic yard in a loose condition so that laboratory design can be expressed in field terms.

Comparison of the appearance of the actual grading curve with the ideal can be enlightening. Where the slope of the composite curve is less than for the ideal in its lower half the soil mortar is apt to be weak during wet periods. If the flattening occurs in the upper end of the composite curve, there will be a lack of interlock among the coarse sizes, and larger particles will contribute little to stability, although they will still serve to increase density. If this skip-grading is pronounced in the coarse sizes, it may become desirable to base the computations on a lower and more representative value of D. In such cases the final step will be to convert percentages from terms of weights passing the chosen value of D into terms of total weight.

As an elementary example, assume that it is desired to stabilize a gravel with 1½-in. maximum size and with 13 percent of the gravel passing the No. 40 sieve. The available binder soil has 90 percent passing No. 40, is 45 percent clay, and has a plasticity index of 20. The mixture is to have a plasticity index of 8. Then $c = \frac{45}{0.90} = 50$ percent and, from the equation $C = \frac{cI}{i}$, the value of $C = \frac{(50)\ (8)}{20} = 20$ percent.

This latter value determines th Point A in Fig. 1, and permits con struction of Line AB. A parallel lin is then drawn through Point F or th "100=1½ in." point. Intersection o this line with the 0.005-mm. line fixe the percentage of clay at 4 percent Since the binder soil contains 45 per cent clay, it follows that the binde will constitute 4 divided by 0.45 o 8.9 percent of the stabilized mix. I should be noted that specified toler-ances can easily be established b drawing lines parallel with and on both sides of the Line EF in Fig. 1 the spacing to be determined by rigidity of control warranted by the specific job. A feature of this procedure is the increased emphasis placed on the importance of the smaller particles.

Assume that the stabilized mix is found by trial to have a compacted dry density of 140 lb. per cu.ft. or 630 lb. per sq.yd. of 6-in. stabilized base. Assume that the available binder soil as hauled weighs 2,000 lb. per cu.yd. Then 8.9 percent by dr weight is equivalent to $\frac{(0.089)\ (6300}{2,000}$ or 0.028 cu.yd. of binder soil per square yard of surface. Both the binders and coarse aggregates may be either natural soils or composite materials blended to improve gradation or plastic properties.

Wartime Priorities Bring Substitute Materials In Municipal Services

City officials are devising ingenious substitutes to pinch hit for materials on which there are war priorities, a survey by the International City Managers Association reveals.

Use of substitutes, together with such conservation measures as pooling of construction and repair equipment, is urged by the War Production Board to release as much vital material as possible for war use. Federal agencies also are at work seeking substitutes for materials needed in manufacturing processes and for finished products with particular respect to governmental service needs.

The use of substitutes by the cities, which find themselves short of supplies, range from sewer pipe to paper clips:

Cincinnati has substituted sheet lead alloy for copper, brass and bronze in flashings; bakelite for screws and bolts, plastic tubing for rubber insulation on electric wire, while pressed plywood and other materials replace metal signs. A prepared paper instead of burlap is used in road construction and cotton and paper bags replace burlap bags.

Dallas uses concrete for manhole covers instead of cast iron, and removable wood moulds instead of steel ones in concrete storm sewer construction. Wooden street signs are going up instead of metal signs, and salvaged rails are utilized instead of I-beams in large storm sewer inlets.

Los Angeles is replacing cast iron manhole covers with wooden lids treated for termites and decay.

San Diego uses scrap metal for reinforcing steel, and concrete pipes instead of steel pipes; salvaged materials are utilized to make miscellaneous truck parts and motor clamps.

Savannah used redwood pipe with cast iron fittings in place of metal water pipe. The City also uses concrete manhole covers but goes others one better by adding precast frames as well.

South Haven, Mich., offers home-made wooden boxes instead of metal ones for electric meters.

In some cities certain employes or departmental committees are assigned to develop and carry out conservation plans, while in others general instructions on conservation are issued by the city manager, mayor or other official.

Pooling plans for use of equipment are left up to the cities and states without centralized control by Washington. Pooling of state-owned motor vehicles, one example of this activity has been adopted in at least 15 states

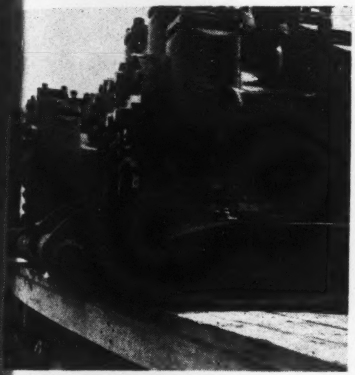
From Field and Office

ORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

id Extension Protects Pump hile in Transit

Skid-mounted equipment, such as mpressors and water-supply pumps, equently withstand more abuse en being moved than when in ac- l operation. Where the ends of h units carry working connections, ious damage can be done to the posed studs, fittings and parts un- s special care be exercised while e unit is being shifted from one cation to another.

One Texas contractor, finding that e original skids were too short to event damage to the suction fit- gs, studs and valve covers on the posed end of a pump added the tension shown in the accompanying hotograph. A minimum of steel was tilized in lengthening the skid, al- hough it was extended sufficiently to ermit the lifting hitch to be made ith plenty of clearance over the end f the pump.



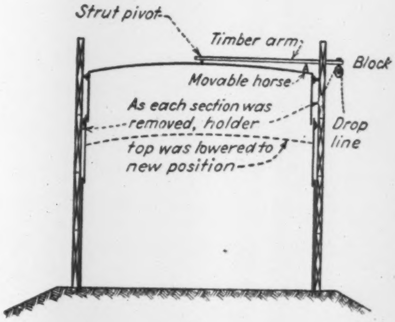
ith little steel required, the skid of is pump was extended to prevent amage to the exposed studs and ttings.

Since new skids, of proper length. ould have required a large amount f steel, the skid was extended. This ork was accomplished by welding o formed, oval plates, across the d of the skid, just inside the H- eam members of the unit. The plates ere cut to fit over the pipe cross ember, and they were welded roughout the line of contact with e old skid. A second cross member—a heavy steel pipe—was next welded to these plates to form a new end to the extension, and a sturdy place for attaching a winch line was thus afforded. The oval plates, thoroughly braced by both cross members, were amply rigid, slid easily over obstacles, and provided needed clearance between the end of the pump and other equipment when the unit is loaded to be moved.—CHARLES C. LYNDE, *P. O. Box 1129, Houston, Texas.*

Dismantling Gas Holder

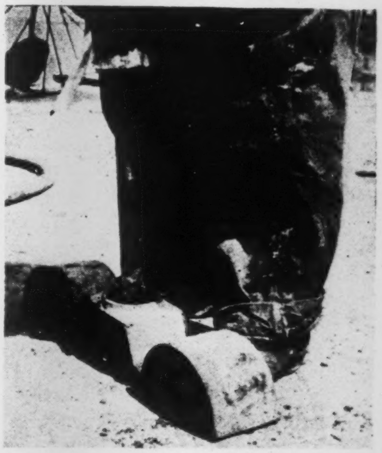
Compressed air greatly simplified the emergency removal of two gas holders during the Arkansas River flood at Little Rock, Ark., in 1927. While the date of the operation is a long way back, the method of doing the work is as applicable now as it was in 1927. An 800,000- and a 1,000,000-cu.ft. holder had to be dismantled. Both holders were of the collapsible water-seal type, with shells held in upper, or extended, position by the pressure of the gas inside. When extended the shells were supported by the usual outside circle of trussed columns.

The first step in dismantling was to evacuate the gas, and as haste was important it was wasted into the air. Because of restricted area, derricks could not be set up to take down the structural columns. Nine air compressors borrowed from the local contractors were assembled and hooked up to the pipelines entering the holders. The holder shells were then extended to the up position by pumping in compressed air.


Strut pivot
Timber arm
Block
Movable horse
As each section was removed, holder top was lowered to new position
Drop line

With the top of the holder available for a working platform the simple arrangement shown by the accompanying sketch was installed to take down the top sections of the columns. Air pressure was then reduced and the holder shell was lowered to a new working position. Repetition of these procedures enabled the removal of all the steel work in a very short time. The work was planned and carried out by A. S. Butterworth, St. Louis, Mo.—*Compressed Air Institute, New York, N. Y.*

Guard for Hammer Operators



On highway construction in the Detroit, Mich., area metal footguards of the type above are proving of great value to pneumatic hammer operators. The guard was developed by the safety and traffic division of the Wayne County Road Commission.

Field and Office Comment

Concrete Column Design

Sir: At present when concrete designers can contribute to the war effort by reducing design time to a minimum, Joseph Zalkin, in his "Charts Speed Calculations for Concrete Columns" in *ENR*, April 8, 1943, p. 505, is to be commended for cutting through some of the unwarranted "red tape" that has long been a part of the design of concrete columns.

I should like to offer another short method of solving the same problem that I have been using with satisfactory results.

With the same assumptions as made in the "Joint Committee" 1940 Code, an expression can be set up for the equivalent axial load on a column due to combined axial load and bending, as has been done in the "A.C.I." 1941 Code, thus:

$$P = N\left(1 + \frac{CDe}{t}\right)$$

(Formula 28, Sec. 1.109.)

This can be expressed as

$$P = N + CD\frac{M}{t}$$

Assuming $f_c' = 2{,}500$ psi. and $f_s = 16{,}000$ psi., the product CD varies very slightly for usual designs encountered.

Therefore for this case use:

$$P = N + 30\frac{M}{t} \quad \text{(for tied columns)}$$

Where P = equivalent axial load in kips
N = actual axial load in kips
M = actual moment in ft. kips
t = depth of column in inches

Then assume a value for t and with value of P obtained, enter Table 18 on p. 82 of the A.C.I. "Reinforced Concrete Design Handbook" and choose a design.—**David Bloom**, *Concrete Designer, E. I. du Pont de Nemours & Co., Wilmington, Del.*

Slide Rule for Square Roots

Sir: During recent months you have printed letters on the use of the slide rule in taking square roots. There still is another variation which appears to be somewhat easier, for which reason it is preferred by those of us who are a bit lazy about figuring.

In taking a square root, there is no reason for carrying out the result to any more figures than are consistent with the intended use. Sometimes a slide rule and a common table of squares are the only tools that are necessary. If more figures are desired than the six that can be obtained by this method, then there can be a small amount of pencil work inserted between the table of squares beginning and the slide rule ending. The work being easy, there is a good chance that the results will be free of error.

Just as the schoolboy does in the arithmetic class, begin at the decimal point and mark off the number in groups of two figures, each end group possibly having only one figure. From a table of squares find the largest three-figure number whose square is less than the first three groups of the original number. Write these three figures as the first part of the root and subtract the square from the original number. If a six-figure result will be sufficient, divide the remainder by the double of the three-figure number plus the quotient and annex the quotient to that part of the root already found. These final three figures are obtained from the slide rule.

When more figures are desired in the root, begin as before, proceed by pencil as many steps as desired, then find the final three figures by slide rule.

The number 5357.94 is chosen because the results have to be read from the right hand end of the slide rule where accurate readings are more difficult. The square root is 73.19795079. If only four decimal figures are desired, we find 73.1 from the table of squares and subtract its square from the original number and then obtain three more figures by slide rule. Necessary work follow

```
        5357.94  (73.1979
        5343.61
  1463)    1433
```

If two or more figures are requir the work is:

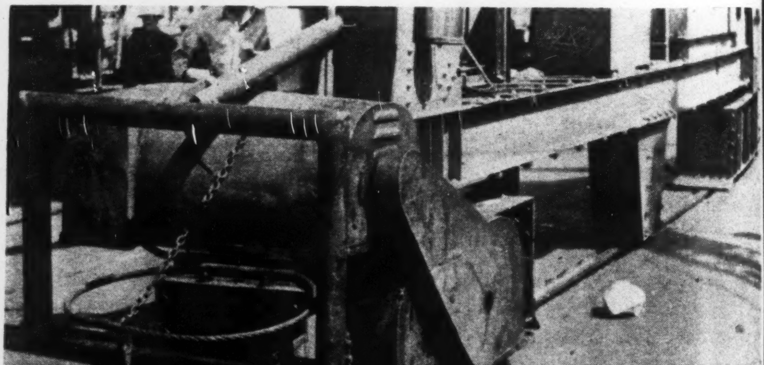
```
           5357.94  (73.197951
           5343.61
   14629)  143300
           131661
  146387)  1163900
           1024709
  146394)   139191
```

The first three figures of the roo and the square of this number ar taken from the table, the second tw are obtained by slide rule, and th final three are read from the rule Since the second divisor will serve th purpose, there is no need to set dow the third, this one being shown her merely to complete the picture. Omitting these six figures, only 63 figures are used. To obtain the same resul the schoolboy would use 142 figures, with a correspondingly larger chance for error.

In the shorter example the score is 26 figures against 99 for the schoolboy. The complete pencil job is recommended for people who prefer to run up a high score.—**Leonard Jordan**, *9 North Ave., New Rochelle, N. Y.*

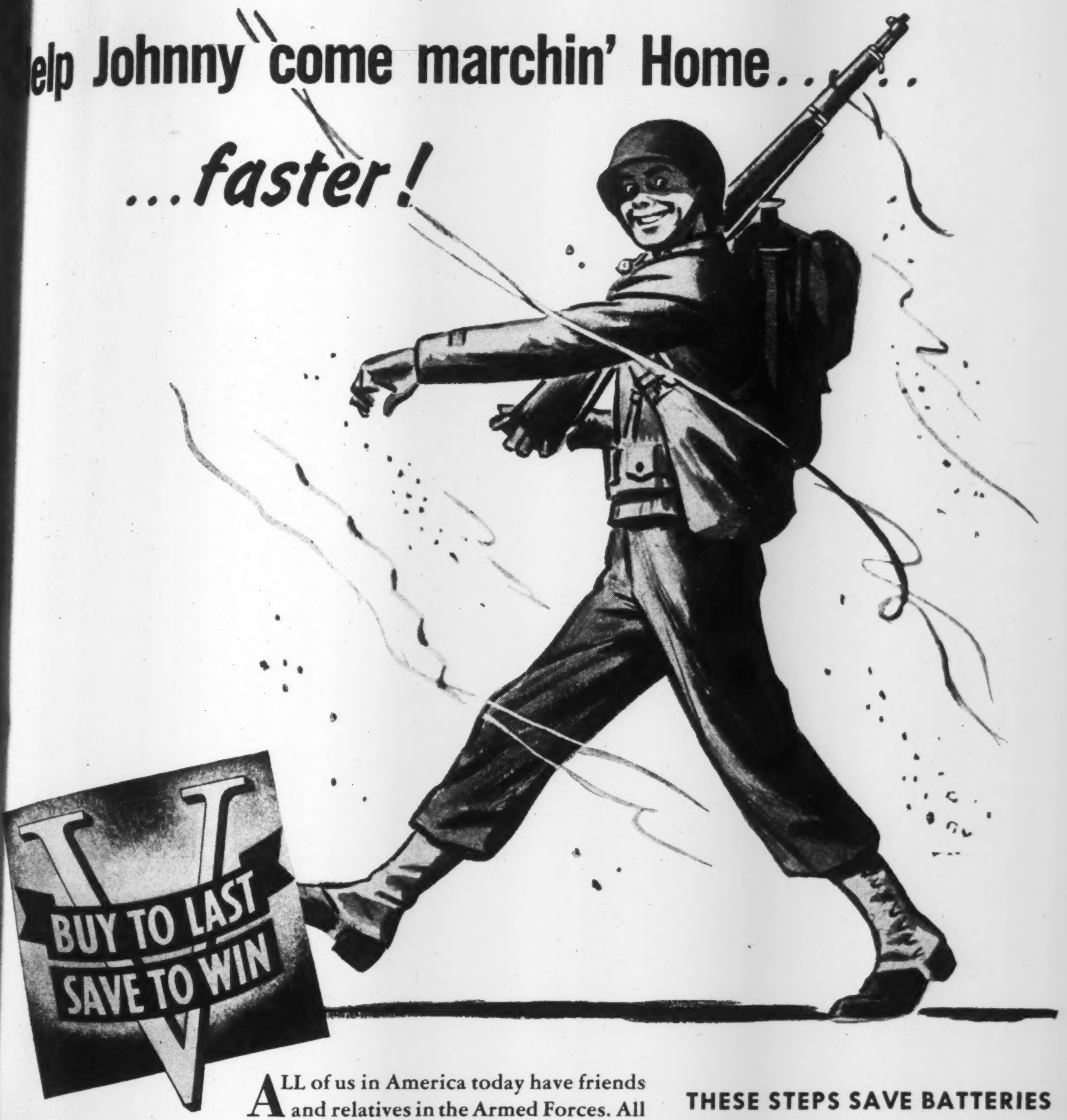
Pipe Bumper on Gantry Cranes

Protection just above track level for the driving mechanism of a large gantry crane at a western shipyard is provided by a rectangular frame of pipe welded firmly to the structural frame of the gantry. This is to protect the mechanism from accidental impact with trucks, piles of material or other heavy objects with which the mechanism might collide. This protection, designed for heavy objects, is in addition to the steel cable bumper, shown in the accompanying picture, intended to give warning to a person standing on the rail as the crane approaches.



elp Johnny come marchin' Home. . . . .

. . . faster!



ALL of us in America today have friends and relatives in the Armed Forces. All of us want to see them marching home soon . . . with the big fight won.

An important way to help them, right here at home, is to practise rigid conservation. First, buy only the best and longest-lasting tools and equipment. Second, give everything you own the best of care, in order to get every last ounce of use. This saves materials and labor . . . sets them free to work on our tremendous armament program.

It's easy, for example, to make your dependable Exide Batteries last even longer, and four simple conservation rules will do the trick if followed carefully at all times. Obey them and you save vital batteries. Buy to Last and Save to Win.

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1 Keep adding approved water at regular intervals. Most local water is safe. Ask us if yours is safe.

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3 Keep the battery fully charged—but avoid excessive over-charge. A storage battery will last longer when charged at its proper voltage.

4 Record water additions, voltage, and gravity readings. Don't trust your memory. Write down a complete record of your battery's life history. Compare readings.

If you wish more detailed information, or have a special battery problem, don't hesitate to write to Exide. We want you to get the long-life built into every Exide Battery. Ask for booklet Form 2399.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia
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CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

TUNNEL SEWER, FORT WORTH, TEXAS

OWNER: City of Fort Worth, Tex., S. H. Bothwell, city manager; Freese & Nichols, engineers.

PROJECT: Construction of 48-in. tunnel sewer in Fort Worth, Tex., including shale and rock excavation in tunnel; concrete tunnel lining; shaft lining; precast concrete pipe in trenches from 6 to 26-ft. deep; monolithic concrete pipe in trenches 6 to 26-ft. deep; junction with existing 54-in. sewer; and connection to existing box at west end of project.

CONDITIONS: Contractor to furnish all materials and complete work in 120 days. Rail and highway transportation facilities available. Wage rates specified are: skilled labor, $1.50 per hour; semi-skilled, 75c.; and common, 50c. Maximum depth of tunnel approximates 80 ft.

LIST OF BIDDERS: (Bids March 23, 1943.)

1. O. J. Parrot, Dallas, Tex. (contract)	$130,130
2. J. G. Bartholomew, Dallas, Tex	192,342
3. Williams & Whittle, Inc., Dallas, Tex	196,825
4. Ben Sira & Co., Dallas, Tex	205,240
5. W. E. Callahan Constr. Co., Dallas, Tex	295,000

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Shale excavation in tunnel	2,750 c. y.	$13.00	$26.25	$28.20
2. Rock excavation in tunnel	1,200 c. y.	15.00	29.75	28.20
3. Concrete lining in tunnel	1,760 c. y.	27.00	29.50	31.30
4. Shaft lining	185 ver. f.	40.00	32.00	10.00
5. Precast conc. pipe — 6 to 8-ft. trench	50 l. f.	7.20	10.80	10.40
6. Precast conc. pipe — 8 to 10-ft. trench	800 l. f.	8.10	11.60	11.10
7. Precast conc. pipe — 10 to 12-ft. trench	300 l. f.	9.00	12.60	12.00
8. Precast conc. pipe — 12 to 14-ft. trench	80 l. f.	11.00	14.70	13.50
9. Precast conc. pipe — 14 to 16-ft. trench	40 l. f.	13.50	16.25	14.30
10. Precast conc. pipe — 16 to 18-ft. trench	40 l.f.	16.00	17.50	18.00
11. Precast conc. pipe — 18 to 20-ft. trench	30 l. f.	20.00	18.90	22.40
12. Precast conc. pipe — 20 to 22-ft. trench	20 l. f.	24.00	20.50	30.00
13. Precast conc. pipe — 22 to 24-ft. trench	15 l. f.	29.00	22.60	42.30
14. Precast conc. pipe — 24 to 26-ft. trench	10 l. f	36.00	24.40	45.20
15. Monolithic conc. pipe, 6 to 8-ft. trench	10 l. f.	14.00	15.70	28.50
16. Monolithic conc. pipe, 8 to 10-ft. trench	50 l. f.	15.00	16.80	30.00
17. Monolithic conc. pipe, 10 to 12-ft. trench	10 l. f.	16.00	18.00	31.30
18. Monolithic conc. pipe, 12 to 14-ft. trench	10 l. f.	18.00	19.00	37.60
19. Monolithic conc. pipe, 14 to 16-ft. trench	10 l. f.	20.00	20.50	40.00
20. Monolithic conc. pipe, 16 to 18-ft. trench	10 l. f.	22.00	22.00	41.80
21. Monolithic conc. pipe, 18 to 20-ft. trench	10 l. f.	25.00	23.70	50.00
22. Monolithic conc. pipe, 20 to 22-ft. trench	10 l. f.	30.00	25.50	54.00
23. Monolithic conc. pipe, 22 to 24-ft. trench	5 l f.	35.00	27.00	65.00
24. Monolithic conc. pipe, 24 to 26-ft. trench	5 l. f.	40.00	30.00	68.00
25. Std. 4-ft. manholes, 6 ft. deep	1 ea.	150.00	200.00	112.00
26. Add'l standard manhole feet	6 ver. f.	10.00	14.00	11.20
27. Junction chamber on exist. 54-in. sewer	Lump Sum	250.00	1,050.00	760.00
28. Conn. to exist box at West End	Lump Sum	100.00	200.00	210.00
29. 1:14 concrete cradle in place	350 c. y.	13.00	9.50	12.60
30. Sheeting left in place, open cut sewer	15 M bm.	20.00	100.00	14.00

STREET IMPROVEMENTS CINCINNATI, OHIO

OWNER: City of Cincinnati, Ohio; Dept. of Public Works.

PROJECT: Improvement of Connecticut Avenue, from Oakwood Avenue to Witherby Avenue, by grading, installing necessary sewer of 15- to 24-in. concrete or vitrified pipe, installing other necessary drains and inlets, making necessary changes in and additions to the water distribution system, installing sewer and water house services within the street lines, laying four-foot cement walks, sodding, and constructing 24-ft. concrete roadway with integral concrete curbs.

CONDITIONS: Contractor to furnish all material, labor and equipment necessary to complete the project, except that the city will furnish sewer and waterworks castings, and the necessary cast iron pipe. Highway, railway and water transportation facilities available. Wage rates in the Cincinnati area are: skilled labor, $1.45 to $1.75 per hour; semi-skilled, 90c. $1.45; and common labor, 85c.

BIDS: Two bids were received March 16, 1943, the contra low of $17,645, and $17,990. These prices were on the bas of the concrete pipe sewers. On the basis of vitrified pipe sewe the only bid received was $18,972 from David Crawley.

LIST OF BIDDERS:

1. W. L. Harper, Cincinnati, Ohio (concrete sewers)	$17,6
2. David Crawley, Cincinnati, Ohio (concrete sewers)	17,9
2a. David Crawley, Cincinnati, Ohio (vitr. pipe sewers)	18,9

Item	Quan.	Unit Prices (1)	(2)
1. Grading, excavation	1,800 c. y.	$0.40	$0.30
2. Removing trees	15 s. f.	4.00	3.00
3. Sodding	1,500 s. y.	.20	.25
4. Concrete pavement, 8-in	2,950 s. y.	2.65	2.63
5. Integral concrete curb, rolling	2,125 l. f.	.25	.30
6. Cement walk	7,200 s. f.	.20	.25
7. Concrete driveways	2,500 s. f.	.25	.30
8. Concrete masonry (1:6)	2 c. y.	18.00	20.00
9. Standard manholes	5 ea.	70.00	75.00
10. Manholes readjusted	5 ea.	10.00	5.00
11. Inlets, gutter, double	6 ea.	40.00	40.00
12. Hauling sewer castings	5 ton	4.00	3.00
13. Brick masonry	5 c. y.	25.00	20.00
14. House drains	500 l. f.	1.00	.80
15. Bends, 6-in	50 ea.	.75	1.00
16. Laying 6-in. cast iron pipe	20 l. f.	4.00	1.00
17. Hauling and setting 6-in. fire hydrants	2 ea.	10.00	10.00
18. Lower existing 6-in. water mains	100 l. f.	.60	1.00
19. Lower exist. ¾- to 2-in. serv. branches	100 l. f.	.75	.80
20. Reset exist. curb and rdway. boxes	10 ea.	1.00	1.00
21. Brick masonry for valve chambers	2 c. y.	30.00	20.00
22. Conc. masonry (1:6), valve chambers	1 c. y.	12.00	10.00
23. Haul waterworks castings	5 ton	4.00	3.00
24. Clean and relay exist. 6-in. pipe	24 l. f.	1.25	1.00
25. Adjust exist. valve chambers	5 ea.	4.00	5.00
26. 15-in. concrete pipe, sewers	210 l. f.	2.00	2.00
27. 18-in. concrete pipe, sewers	20 l. f.	3.00	3.00
28. 21-in. concrete pipe, sewers	840 l. f.	4.00	4.00
29. 24-in. concrete pipe, sewers	60 l. f.	4.50	5.00
30. 12-in. conc. pipe inlet connections	130 l. f.	1.50	1.85
31. T-branches on 15-in. conc. pipe sewer.	7 ea.	1.50	2.00
32. T-branches on 21-in. conc. pipe sewer.	30 ea.	3.00	4.00
26a. 15-in. vitr. pipe, sewers	210 l. f.	No Bid	2.25
27a. 18-in. vitr. pipe, sewers	20 l. f.	No Bid	3.50
28a. 21-in. vitr. pipe, sewers	840 l. f.	No Bid	5.00
29a. 24-in. vitr. pipe, sewers	60 l. f.	No Bid	6.00
30a. 12-in. vitr. pipe inlet connections	130 l. f.	No Bid	2.00
31a. T-branches on 15-in. vitr. pipe sewer.	7 ea.	No Bid	2.00
32a. T-branches on 21-in. vitr. pipe sewer.	30 ea.	No Bid	4.00

* *Engineer's estimate.* *a Denotes alternate allowed for concrete pipe sewer construction.*

CLEAN AND LINE WATER MAINS NEW JERSEY

OWNER: City of Newark, N. J.; William Banks, engr.

PROJECT: Cleaning and relining 78,000 feet of 48-in. riveted steel pipe in water line between Macopin Intake and We Paterson, N. J. Pipe to be lined with ⅜-in. protective coatin of cement mortar. From the intake, water line passes throug Pequannock, Butler, Kinnelon, West Milford, Wayne, Litt Falls, Totowa, and West Paterson.

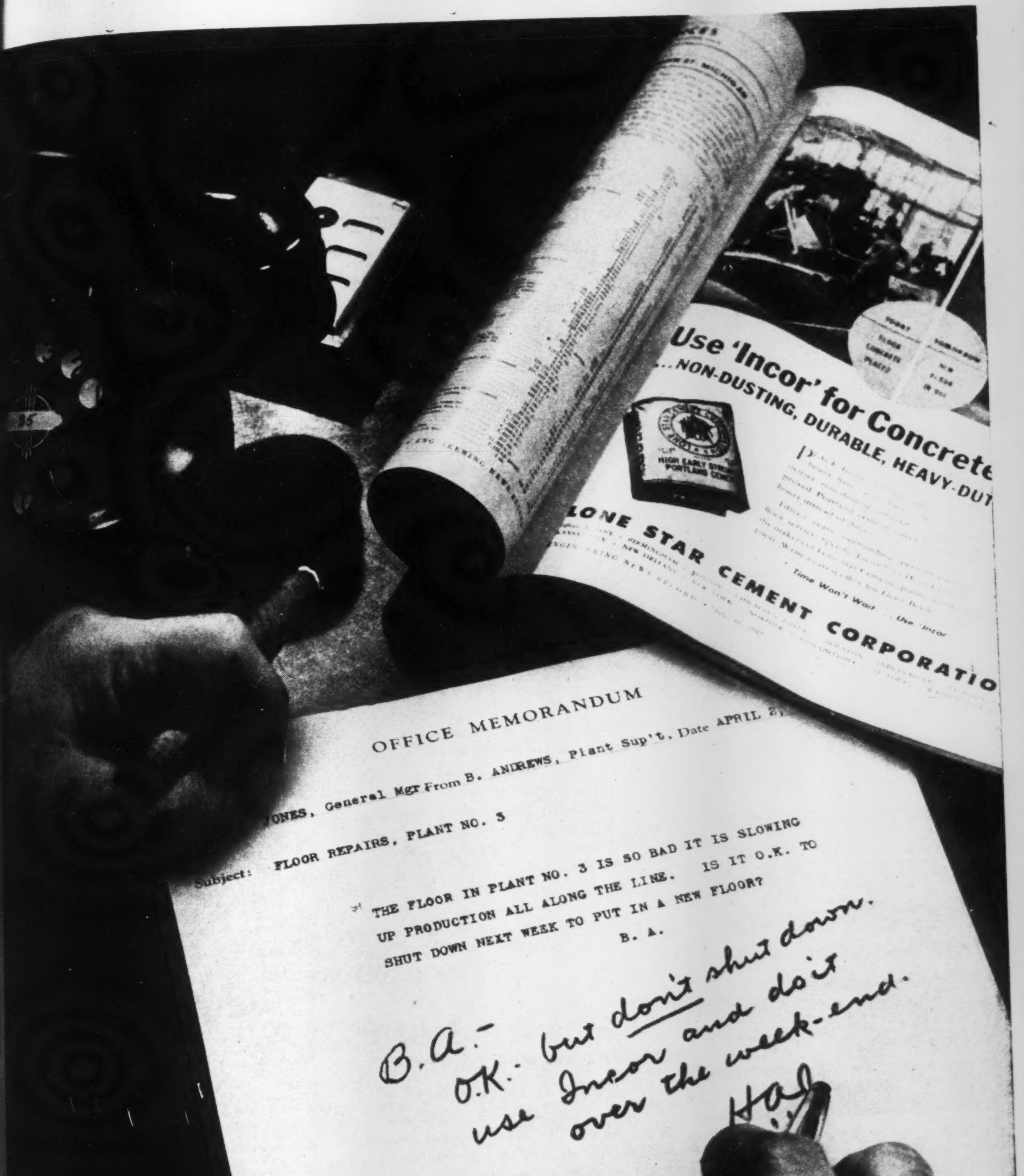
CONDITIONS: Contractor to furnish all materials, and n specific time for completion is stipulated. Highway transpor tation facilities available. Wage rates range from 87½c. f common labor to $1.50 for skilled labor.

BIDS: Four bids were opened March 16, 1943, but two wer irregular. Regular bids were the low of $226,200 and $273,00

LIST OF BIDDERS:

1. J. Nesto & Co., Newark, N. J (low bidder)	$226,2
2. Lock-Joint Pipe Co., Newark, N. J	273,0

Item	Quan.	Unit Prices (1)
1. Cleaning and lining 48-in. water pipe with ⅜-in. protective coating of cement mortar	78,000 l.f.	$2.90



OFFICE MEMORANDUM

JONES, General Mgr From B. ANDREWS, Plant Sup't. Date APRIL 2

Subject: FLOOR REPAIRS, PLANT NO. 3

THE FLOOR IN PLANT NO. 3 IS SO BAD IT IS SLOWING UP PRODUCTION ALL ALONG THE LINE. IS IT O.K. TO SHUT DOWN NEXT WEEK TO PUT IN A NEW FLOOR?

B. A.

B.A.—
O.K.- but don't shut down.
use Incor and do it
over the week-end.
H.A.J.

Use 'Incor' for Concrete
...NON-DUSTING, DURABLE, HEAVY-DUT
HIGH EARLY STRENGTH PORTLAND CEMENT
Time Won't Wait ... Use Incor
LONE STAR CEMENT CORPORATIO

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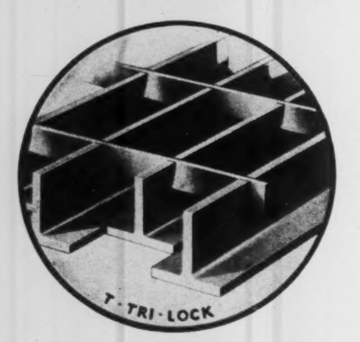

NEWS OF THE WEEK

(*Continued from p. 57*)

Increased enrollment of engineers at Columbia

Enrollment in undergraduate courses in the School of Engineering at Columbia University has shown a remarkable increase during the past year, James Kip Finch, associate dean of the school, reports. This gain is attributed in part to the urgent plea of the United States Office of Education to all engineering schools to redouble their efforts and to train the maximum number of men as rapidly as possible.

"As a result," said Professor Finch, "there has been a further increase in our undergraduate enrollment, a gradual withdrawal of graduate students who, because of the pressing needs of industry and government could no longer devote their time to graduate study, a similar withdrawal of certain staff members for service in the armed forces or for special research duties, and an expansion of the Engineering, Science, Management and War Training program."

Freshman and sophomore enrollment in the engineering school has almost doubled, while junior, senior and special engineering course students have fallen off in number. Freshman enrollment is now 249 students, as compared to 128 in 1938. There are 200 sophomores, and in 1938 there were 154.

• • •

Lt. Comdr. H. F. Ransford heads Seabee center

Lt. Comdr. H. F. Ransford (CEC) USN, is now executive officer for the Naval Construction Training Center, Peary, and second in command of all Seabees training in Virginia. Prior to assuming the position recently made vacant by the illness of Comdr. R. H. Meade (CEC) USN, Comdr. Ransford was executive officer for the Allen and Bradford training centers.

Following graduation from the U. S. Naval Academy in 1924, Commander Ransford served for five years aboard the USS *California*, and then in 1929 he was assigned to the San Diego area for flight training. When given a choice between further flight training and post graduate training in engineering at the academy and at Rensselaer Polytechnic

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    Menands
  Binghamton — MacDougall Equipment Co.
  Buffalo — Dow & Company, Inc.
  Corona, L. I. — The Jaeger-Lembo Machine Corp.
  Middleton — S. T. Randall, Inc.
  New York—Hubbard & Floyd, Inc.
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  San Antonio — Patten Machinery Company
VIRGINIA
  Richmond — Highway Machinery & Supply Co.
WASHINGTON
  Seattle — Star Machinery Company
  Spokane—Andrews Equipment Service
WEST VIRGINIA
  Fairmont — Interstate Engineers & Constructors
WISCONSIN
  Eau Claire — Bradford Machinery Company
  Green Bay — Nelson Machinery Company
  Madison — Western Equipment Company
WYOMING
  Cheyenne — Wilson Equipment & Supply Co.

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Worthington Pump and Machinery Corp.

A GOOD MAN WITH BRUTES

’em, rent ’em, get ’em fixed . . . he’s man to depend on when you’re jam or want to *keep out* of one.

the Worthington distributor, the who handles Blue Brutes — coms, rock drills, air tools.

u need a Blue Brute — or several . . . he’ll do his darndest to get it as soon as possible after you hang r phone. If your Blue Brutes are a stiff schedule, he’s the man to them to for a “physical” — a wise tion these days when replacements are hard to get. If rough treatment has turned up bruises or breaks, he’s got a “first aid kit” of supply parts and repair “know-how” that will restore their pep and vigor.

They make quite a team. Rugged, easy-breathing Blue Brute Air Compressors with the improved and famous “Feather* Valve” . . . easy-handling Blue Brute Rock Drills and Air Tools for a wide range of work . . . and capable, cooperative Blue Brute Distributors whose job is helping you get *your* job done.

Behind the Fighting Fronts with

BLUE BRUTES

Blue Brutes on the Alaskan highway help punch through the vital life line that will help the U. S. Army smash the Japs! In addition, Blue Brutes are at work today on hundreds of Army, Navy and Air Force projects all over the country —in “uniforms” of olive drab and battleship gray, instead of customary blue.‡ Your nearest distributor is listed on page 100.

S. Pat.

ute Compressors and Air Tools are painted olive drab for the Army and battleship gray for the Navy.

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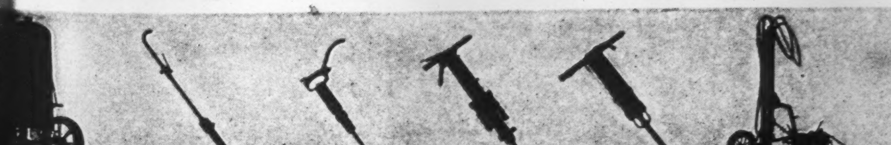
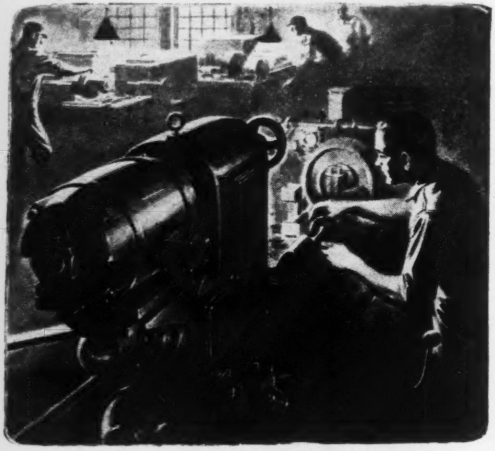


ors from 60 to 500 cu. ft. capacity in mount-t all jobs. Rock Drills and Air Tools that have always set the pace for easy operation — available in a wide range of weights and sizes.

WORTHINGTON

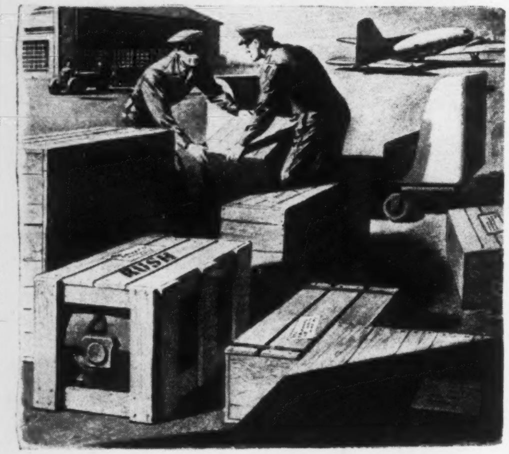
Worthington Pump and Machinery Corporation, Harrison, N. J. Holyoke Compressor and Air Tool Department, Holyoke, Massachusetts

This motor got on the job



"Rush new motor Air Express" was the order a supplier received at 9 A.M. Ready for pickup at 10, it was taken to the airport, flown hundreds of miles to destination . . . and installed on a vital war job that same afternoon.

This motor was delayed



Shipments ready for morning pickup but held for "late afternoon" routine, may be subject to delay. Heavy, peak-hour traffic may keep them grounded until a midnight or early morning plane.

For FASTEST delivery–Air Express!

To move emergency parts and critical material at 3-mile-a-minute speed, Air Express is on the job around the clock—not only on the home front, but working hand in hand with Army and Navy Air Transport services to supply our fighting fronts throughout the world.

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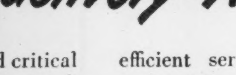

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Representing the AIRLINES of the United States

Institute. Commander Ransford elected to take the latter.

During the spring of 1938. Lt. Comdr. Ransford was assigned to Guam as public works officer, where he remained until the summer of 1940, at which time he returned to San Diego. It was from that station that he was called to Washington when war struck in the Pacific, and the Seabees came into being. He was assigned to Camp Allen as training officer and last fall became Allen and Bradford executive officer, succeeding Comdr. Harry A. Bolles, who is now in a key Seabee position with the Bureau of Yards and Docks in Washington. D. C.

• • •

Dispute between unions settled at Dodge plant

Installation of piping was resumed last week at the Chicago Dodge plant of Chrysler Corp., following several days inactivity due to a dispute between the plumbers' union and steamfitters' union over the right to connect piping with water mains. The dispute ended when Joseph A. Keenan, associate director of the War Manpower Commission, ordered the plumbing contractor to permit members of the steamfitters' union to proceed with the work.

• • •

Wood to replace millions of tons of metal in 1943

Conversion to wood of products previously manufactured of metal will release to war service more than five million tons of metal during 1943, technicians of the National Lumber Manufacturers Association, Washington, D. C., estimate. This figure is compiled from reports of WPB, Army, Navy, Maritime Commission, Forest Service, Census Bureau, and industrial concerns.

Statisticians of the Association find that, on the average, it is possible to save one ton of steel by the use of one thousand board feet of lumber. On some items, such as cast iron, it is possible to save more; on others, such as sheet metal, less.

Last year wood began to be used for metal in construction. Now the cantonment building program, the shipyards and the factories are almost complete and the industrial effort has shifted from construction to production. Wood is being used this year to replace metal in a long list of civilian products that otherwise have been largely curtailed, discontinued, or diverted into essential war s other than construction projects. Expenditures for construction in 1942 ched an all-time high of $6,170,000,-0. Had it not been that timber re- ced structural steel so extensively, a ilding program of this magnitude uld have been impossible, it is said. e saving of structural steel in roof sses alone through the use of timber nnector construction has been esti- ted by the Timber Engineering Co. at 0,000 tons.

Manufacture of some 2,200 metal items s been stopped entirely. Many of se are still being produced in wood. many instances the use of wood is w in modern industrial practice.

• • •

New WPB regulations affect sewer connections

Builders are now authorized to make use and project connections to sewage cilities if they meet limits and costs forth under the provisions of Sup- ementary Preference Rating Order 141-a, and if their municipal authority dresses to WPB a letter of certification. e War Production Board has an- unced.

Such a letter must certify that the oject served is authorized under L-41 hich rigidly controls civilian construc- on); that the cost of the material for wer connections is less than $1,500 for nderground construction or less than 00 for other construction; and that e connection is built in accordance ith Housing Utilities Standards. The tter of itself constitutes authorization construct sewage connection facilities. eviously, industrial and domestic cus- mers needed direct permission from PB.

• • •

Much land acquired for the D.C. park system

Completion of about 75 percent of e land acquisition program for the velopment of the District of Columbia creation and park system was reported pril 15 by the National Park and Plan- ng Commission. Since passage in May, 1930, of the act, which authorized $16,000,000 for this purpose, nearly $10,000,000 has been appropriated and spent.

Included in the program completed us far, it was said, are 26 recreation eas and 138 small play areas. Despite e war, the commission plans to go ead with necessary park development, e reason being it desires to acquire

STAGE SETTING FOR A
MURDER!

AVOID DESTRUCTION for your rubber-sheathed cords and cables by protecting them against conditions that accelerate failure . . . by more care in handling . . . by repairing promptly and properly.

SUN AND HEAT. Avoid as far as possible exposure to direct sun rays. Look for sections exposed to excessive air temperatures and avoid "hot spot" locations.

ABRASION AND KINKING. Use guards or protective covering wherever possible. Uncoil and operate to avoid twisting, kinking, and excessive temperature rise. Use reel with largest possible drum diameter.

OIL AND CHEMICALS. Wipe off regularly and clean with washing soda solution. Remove from oil and chemical exposure as soon as possible or paint with a corrosion-resistant coating.

OVERLOADING. Check actual loads against rated amperage; also fuse and circuit breaker contacts. Correct temporary wiring as soon as possible.

Repair *nicks and cuts* immediately with tape; then shellac the taped areas. Trim back *broken sheath*, tape to same thickness as original jacket and patch vulcanize if possible; or apply tape extending beyond repair, then friction tape half-lapped overall and finish with waterproof paint.

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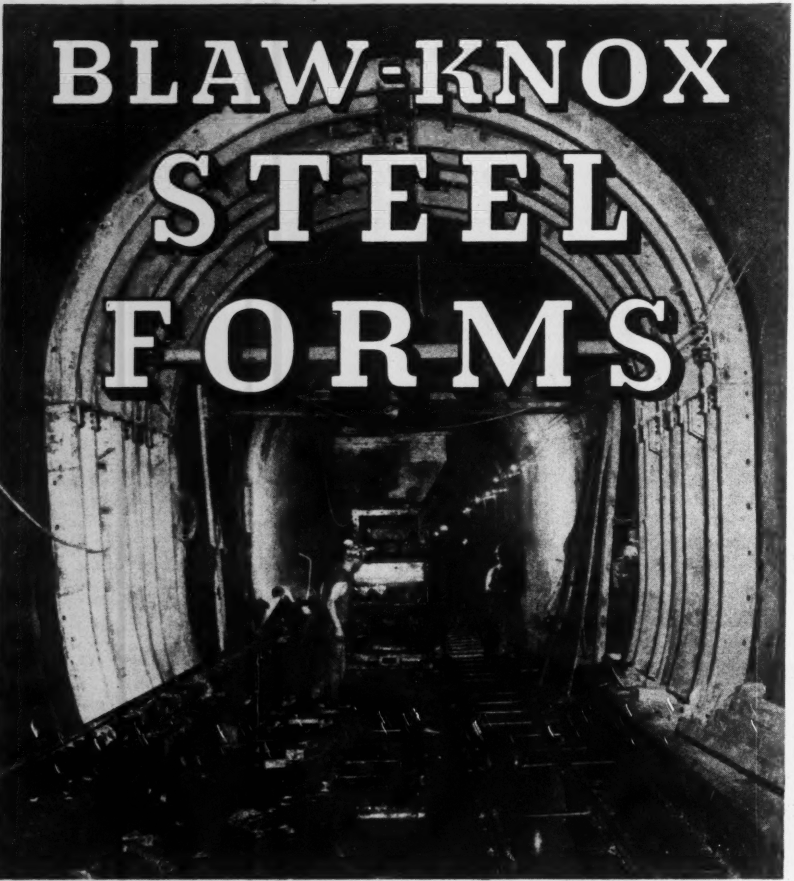
The engineering facilities and services extended by Blaw-Knox form engineers are prized by all who have taken advantage of them. This service is offered in the interest of engineering progress and is free from any charge or obligation.



BLAW-KNOX STEEL FORMS are used for the construction of
TUNNELS WALLS SEWERS DAMS BRIDGES PIERS
CONDUITS ROADS SEWAGE DISPOSAL PLANTS . . .
. . . and other varieties of concrete construction

BLAW-KNOX DIVISION of Blaw-Knox Co.
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land before prices become too high. Th scenic Fort Meade drive encircling th city of Washington is an example of thi policy. All the land required for thi long-planned highway has now been pur chased, final parcels having been adde in recent months.

The commission has taken action look ing to the early purchase of the final lin of private property needed to complet the right of way for the proposed Balti more-Washington parkway between th District line and Fort Meade. The com mission voted to cooperate with th Maryland planning group in completin the survey and appraisal of the tract an to enter into a formal agreement for it purchase.

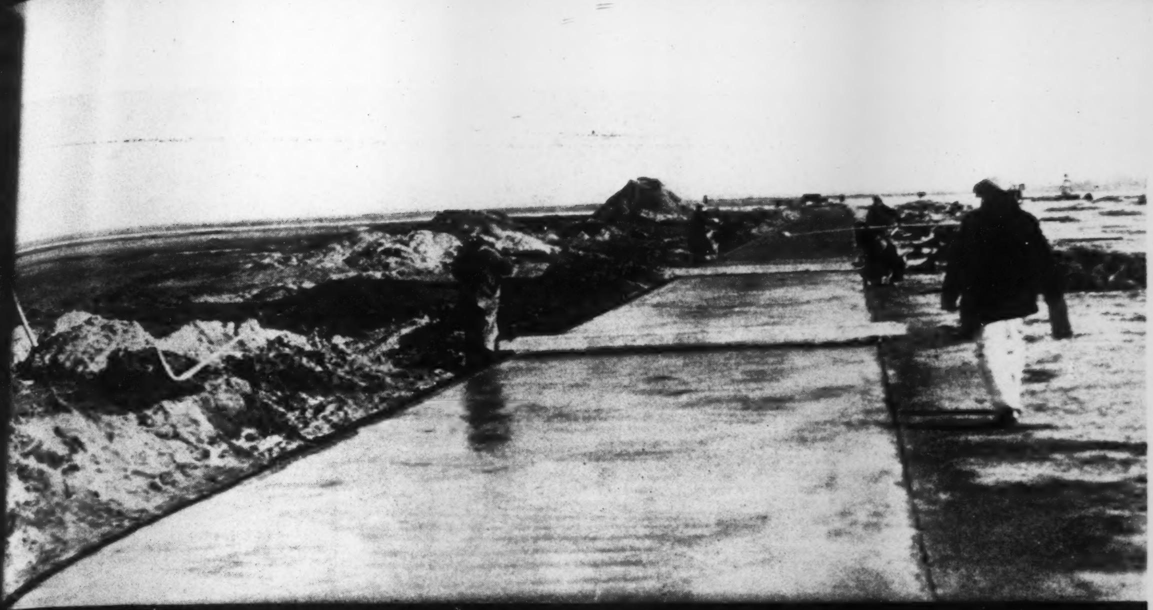
BRIEF NEWS

The Iowa Highway Commission estimates that gas tax and motor vehicle fee receipts will remain high enough to cover maintenance, bond and interest payments, and emergency construction at least through the calendar year 1944. A recent report shows that the $15,898,000 received from these sources in the ten months ending April 1 of this year was only about $3,000,000 less than in the same period of 1941-42. The decline was about equally divided between the gax tax and the motor vehicle tax.

A resolution has been adopted by the Oklahoma State Highway Commission allocating $500,000 for engineering work on a postwar highway construction program. A portion of the amount will be apportioned each month as needed. The plan is to have a program ready to start on a day's notice after the war ends.

A plan to fill the proposed Columbia Bottoms airport site to a point above flood level instead of building a levee around it is being discussed by the St. Louis, Mo., Municipal Airport Commission. The plan has been submitted to the U. S. Corps of Engineers for consideration. Tentative plans for the airport call for six runways ranging in length from 5,000 to 7,000 ft.

A reorganization of the Arkansas State Highway Department which may result in the appointment of an executive business manager and the retention of Director W. W. Mitchell as chief engineer in charge of construction and



EXPANSION JOINT

that MAINTAINS ITSELF!

o construct pavements that may be maintained ith minimum man-power and expense, use

Carey Elastite

ASPHALT JOINT

The Joint Which Maintains Itself

A well known engineer, who has had to main- ain thousands of miles of concrete pavement n which premoulded Asphalt Expansion Joints ere used, says: "We are about convinced that he filling of the openings adjacent to pre- oulded asphalt expansion joints is a waste of aterial. As long as there is a fair thickness of xpansion joint material in the joint, we believe hat material entering the crack along side of the oint material will not cause spalling but will mbed itself in the joint material and be ex- ruded at a later date."

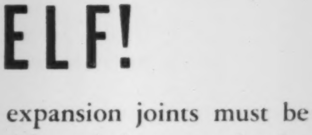
We know that all expansion joints must be cleaned and poured with asphalt at regular intervals; and we cannot tell you how to avoid this maintenance altogether; but we know that Premoulded (extruding) Asphalt Joints are self-cleaning and need only to be partially full of asphalt in order to be effective.

Use Carey Elastite (extruding) Asphalt Joint —the material which not only provides expansion room in the pavement but which keeps the expansion joint free of incompressible material.

HANDY POCKET RULE

MAILED UPON REQUEST

Carries Engineers' and Architects' scales. Also, tables showing inches and fractions of an inch in decimals of an inch or foot.



Please make your request on your Company's letterhead. Address Dept. 30.

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Dependable Products Since 1873 **LOCKLAND, CINCINNATI, OHIO**

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STOP WATCH TELLS WHY
GEAR NOISE IS Costly
Fuller
TRANSMISSIONS

Any transmission can be quiet-running in direct drive. It's when the gears are working that noise is the danger signal, meaning wear. These potential wear-periods are longer and more frequent than many of us realize.

A recent publication by the California Railroad Commission includes some stop watch studies of typical freight runs between Los Angeles, Fresno and San Francisco. Trucks carrying observers operated 3,451.2 miles in a total running time of 6,885 minutes—2,067 of those minutes, or 30.18% of the time, in one of the lower gears. Incidentally, there were 3,279 gear shifts during the operation.

These figures demonstrate the importance of choosing transmissions with care. Fuller Transmissions are *quiet*, which means they are not subject to excessive wear when the gears are in use—and that's more than 30% of running time in the cases observed. That's why it pays to remember Fuller whenever you think about a heavy-duty job.

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Easy to Install

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maintenance, is being discussed. Mitchell added the chief engin duties to those of director when W Zass, who had held the job many y joined the armed forces. Under proposed new program, he would main in charge of engineering work w the business manager would take the top position.

Persons engaged in construc bridges, buildings and similar works normally receive materials "tailor-ma for specific projects will not be requi to set up combined inventory record include such materials, the War Pro tion Board has ruled in issuing Invent Direction No. 6 to CMP Regulation 2. However, such items must be se gated for each project.

Governor Raymond E. Baldwin Connecticut has approved payment $5,800 to the M. A. Gammino Constr tion Co., Providence, R. I., in a c promise settlement of claims arising of delayed construction of bridges approaches at Ledyard, Conn., in 19 Attorney General Pallotti negotiated compromise settlement that resulted i saving of $4,809 from the original cla of $10,609 and a saving of $1,370 fro settlement recommended by the st highway commissioner in 1939.

The 1941 Connecticut General sembly approved a bill authorizing Providence company to institute a s for $10,609 to collect for damages a loss. The court hearing was never f ished. Basis for complaint by the co tracting company was that after the co tract was awarded for the project a work started, plans were changed. D lays caused by the state resulted extra work and loss of funds to the co tractor due to machinery and equipme being kept idle.

South Dakota state highway commi sion has granted raises of from $5 $15 a month to all of its employees.

Because the city of Milwaukee lac much fundamental data for the prop integration of highway projects und consideration in its long-term impro ment program, city officials have direct Walter M. Swietlik, commissioner of pu lic works, to ask the Wisconsin sta highway commission to establish a pro ect for highway planning under a fe eral works program.

The Southeastern Regional War Pr duction Board with jurisdiction Georgia, Alabama, Mississippi, Tenne see, Florida and the Carolinas, leads

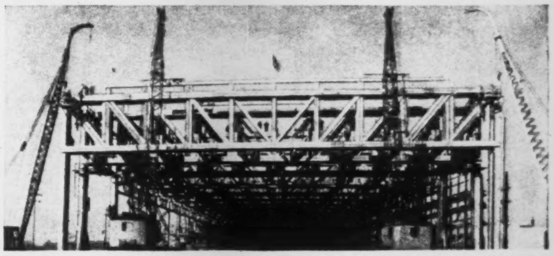
REEDOM IS NOT FREE—IT IS PRICELESS ★ *BUY WAR BONDS*

GUARDIANS OF VITAL WAR MATERIAL

WOOD GOES TO WAR

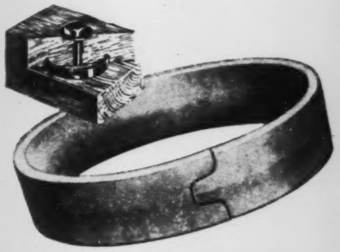
An MGM Technicolor short by James A. Fitzpatrick. Ask your theater when you can see it.

Timber Builds Great Plants for War and Peace



A section of the giant, all-timber assembly plant of the Douglas Aircraft Company, just opened for operations. Architect-Engineer-Manager, The Austin Company, Chicago.

Engineers, Architects, Designers, Builders in every field of industry now are using engineered timber for heavy duty structures. The TECO Timber Connector System made this possible. You, too, can design in timber with TECO. Write for our literature today.



The ***TECO*** *Ring Connector spreads the load on a timber joint over practically the entire cross-section of the wood . . . brings the full structural strength of lumber into play.*

TIMBER ENGINEERING COMPANY

NATIONAL MANUFACTURERS OF **TECO** TIMBER CONNECTORS AND TOOLS

WASHINGTON, D. C. PORTLAND, OREGON

A Little Metal Saves a Lot—*the Amsco Way*. . . . .

Current uses of Amsco welding products present numerous instances where substantial quantities of critical metals have been saved, and important monetary savings effected at the same time.

A Pennsylvania quarry forestalled rapid wear of its gyratory crusher concaves by hard-surfacing them with ¼″ Amsco Economy Hardface welding rod. This self-hardening rod is highly resistant to both impact and abrasion — much more so than the parent metal in this instance—and deposits with a Brinell hardness of 450 to 550.

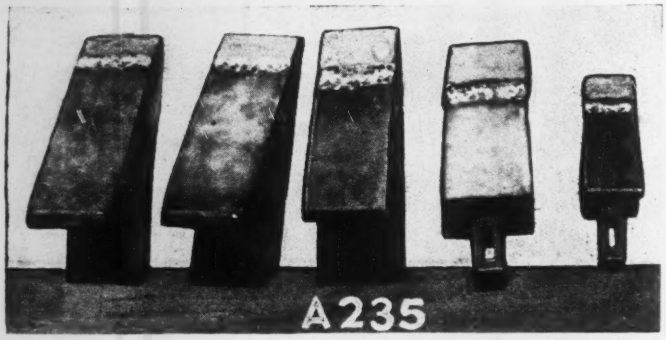
The service life of the segments, one of which is shown in View A-234, was greatly increased. The cost of the hard-surfacing was much less than the frequent purchase of new and hard-to-get castings. Such applications permit the use of the more readily available metals, reducing consumption of scarce materials.

For obtaining additional service from badly worn equipment parts, such as bucket teeth, tractor grousers, dipper fronts and cutter head blades and teeth, Amsco cast repointer bars or rolled special shapes have proved effective. After using Amsco Nickel-Manganese Steel welding rod to weld on the repointer bar and fill the voids, one of the Amsco hard-facing welding rods can be applied. The dipper teeth shown in View A-235 were salvaged by repointing and hard-facing by a Canadian job welding shop — a little metal used to save a lot.

These times demand the application, where possible, of rebuilding and hard-facing to insure maximum service life from ferrous equipment parts subjected to abrasive or frictional wear.

Write for Bulletin 941-W on Amsco Welding Products.

A234



A235

Amsco
AMERICAN MANGANESE STEEL DIVISION
Chicago Heights, Illinois
FOUNDRIES AT CHICAGO HEIGHTS, ILL.; NEW CASTLE, DEL.; DENVER, COLO.; OAKLAND, CALIF.; LOS ANGELES, CALIF.; ST. LOUIS, MO.
OFFICES IN PRINCIPAL CITIES

THE AMERICAN
Brake Shoe
AND FOUNDRY COMPANY

regions in supplying used constru machinery for defense work, it has announced in Washington by the W

The statement shows that more 1,000 tractors, power shovels, gra scrapers, draglines, dump trucks similar units have been supplied by region for projects ranging in loca from the Alcan Highway to Panama the Solomons.

Work has been started on the Val Community Hospital at Vallejo, C This 262-bed institution is being c structed by the Emergency Operati Unit of the Public Buildings Admi tration of the Federal Works Agen and will provide adequate hospital fa ities and service for the 100,000 people that section. It will have an emerge capacity for 300 to 350 beds.

A plan for rehabilitation of the sl areas of St. Louis and Kansas City, M by private capital is permitted under bill recently passed by the Misso House of Representatives. The meas authorizes the formation of redevel ment corporations which would oper under city supervision.

The Roads, Rivers and Bridges Co mittee of the Connecticut General A sembly has voted favorably on a bi that will provide an outright grant between $5,000 and $6,000 to towns f roadbuilding. The bill will abolish th state aid highway fund and transfe the annual million dollars of state a grants to the town aid fund to be d tributed equally among all the towns The present town aid grants amount t $17.600 a year in addition to the millio dollar fund which is distributed pr rata on the basis of the total mileage o unimproved roads in each town. Stat aid money has been available to th towns on a matching basis with the towns contributing one-eighth or one-quarte of the cost of the contracts, depending o financial condition of the communities

A War Production Board Limitatio Order, as amended and effective April 2, 1943, permits certain relaxations in the manufacture and use of metal lath permitting the use of rib type metal lath suitable as a combination form and reinforcement for cast-in-place concrete or gypsum floor and roof slabs; also for use by, or for delivery to, a manufacturer of (a) metal reinforced mineral wool insulation blankets, (b) metal reinforced mineral wool insulating pipe coverings, (c) metal reinforced filters, or crude oil reduction equipment.

WHEN YOUR GAUGES SAY
OVERLOAD!

ROW IN YOUR CHLORINATION RESERVES

Perhaps wartime conditions are crowding your water system to its limit. Congestion in population, and factories working double shifts, may be loading your treatment facilities beyond their normal capacity. Under such conditions, don't overlook the *reserve* possibilities of W&T Chlorinators to relieve the strain on your treatment plant.

Prechlorination may be used to help reduce the load on filters and to eliminate slime deposits that may be impeding the flow in pipelines or valves. Break-point chlorination may enable you to draw on additional sources of water that otherwise would not be suitable to use. If emergency supplies must be used without complete treatment, adequate chlorination will assure safety in any event.

The chances are that your present W&T Chlorinators, including stand-by units, have capacity adequate for this *reserve* service. If not, inexpensive adjustment may provide this extra capacity.

Even though your problem may be a highly individualized one, your Wallace & Tiernan Representative is familiar with so wide a variety of situations where W&T equipment has provided the reserves to meet unusual demands that he can give valuable constructive suggestions. Why not get in touch with him today?

SA-149

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MANUFACTURERS OF CHLORINE AND AMMONIA CONTROL APPARATUS
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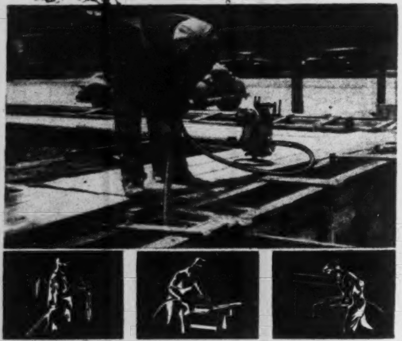

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ON 8 VITAL JOBS

Mall 1½ H. P. GASOLINE POWERED UNIT

VIBRATING — places low-water-cement ratio concrete better and faster than hand puddling. Saves sand, water and cement. It eliminates honeycombs, voids and expensive hand patching. It also assures a better bond with reinforcement and permits an earlier stripping of forms.

WET RUBBING — one man can put a finer finish on 5 times the area possible with hand methods.

SAWING — squaring form boards to size and salvaging waste pieces for bracers, etc., with circular saw.

SANDING—saves time and lumber as form boards can be cleaned and feather-edged for further use right on the job.

PUMPING—excavations—1500 g.p.h. at 10 ft. head.

DRILLING — in wood, steel, brick and concrete.

ALSO WIRE BRUSHING and SHARPENING TOOLS.

Air cooled gasoline engine delivers variable speeds from 1000 to 3700 r.p.m. to the 8 quickly interchangeable tools for the jobs above. Engine uses very little fuel.

•

Mall PORTABLE POWER TOOLS

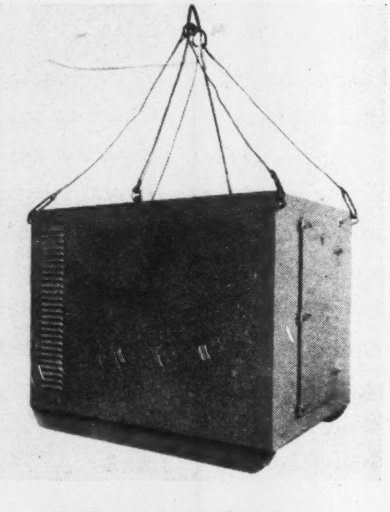
Available for VICTORY Construction — full details upon request.

MALL TOOL COMPANY
7730 SOUTH CHICAGO AVE.,
CHICAGO, ILLINOIS

NEW AIDS TO THE CONSTRUCTOR

Tank Linings

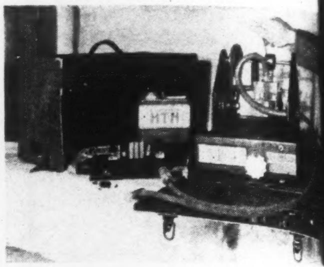
A method of bonding solid sheets of Koroseal directly to welded steel, wood, or concrete which cannot be done with rubber because of physical limitations is announced. Koroseal is the plasticized polyvinyl chloride developed and used in many places instead of rubber. According to the manufacturers it can be applied in thicknesses up to and including $\frac{3}{32}$ in.; it is not subject to physical damage and pin-hole leaks suffered by many corrosion resistant paints; it is more resistant to abrasion than corrosion-resistant paint films; it is readily repaired; it has high electrical resistivity and prevents current losses in electrolytic action; it can be easily tested for leaks with an electric tester; and it is highly resistant to oxidation, water, sunlight and gas diffusion.—*B. F. Goodrich Co., Akron, Ohio.*



Refrigerated Carriers

Both food deliveries and permanent storage are made possible by means of a portable refrigerated carrier of 150 cu.ft. storage capacity, developed to meet U. S. Army and Navy engineers' specifications. The carrier may be moved easily from place to place, its refrigeration mechanism continuing to function without letup. When it becomes sary to move a box over rough it may be towed on skids behind a or tractor. or it may be lifted by a and carried in a truck.

The generator stops and starts matically within prescribed temper ranges.—*Weber Showcase & Fixture 5700 Avalon Boulevard, Los Calif.*



Midget Size Vari-feeder

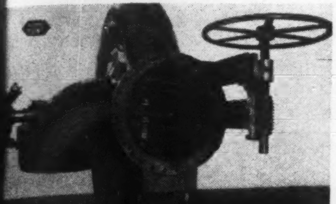
A new product for emergency sterilization or any other chlorinat usage is the Hi-speed, midget size feeder. It is characterized by extr portability, the complete outfit, ing protective case, with test kit and cessories measuring only 10x18x14 and weighing only 44 lb. This small is possible because of a very high ing rate—200 injections per minute contrasted with the usual 10 to 40. the Var-I-feeder delivers as chemical per hour as other larger but delivers it in an approximately tinuous stream. Other features

(1) Streamlined through flow crock to pipe line, involving minim changes in direction and elimination small channels which create pressure or overload the motor and drive and finger-tip control of speed and while the machine is operating. latter is accomplished simply by turn a small wheel with the finger, until needle points to the proper rate on graduated scale, which is illuminat for easy reading and indicates stro per minute, pounds of chlorine per and gallons per hour pumpage

ed for typical waters with standard chlorite solution strengths.

) Long life due to short stroke and l diaphragm. The effective diameter e latter is only 1 in. and the maxi- stroke length only 1/10 in. This t stroke assures minimum diaphragm mation or stretch.

) Transparent illuminated reagent The optical characteristics of ic and a small electric bulb im- led in the reagent head provide not transparent visibility of the ap- tus inside, but also illuminate so the operator can view the reagent rly, the diaphragm and also check valve action. Thus he can be re- red that there is no entrained air e pumping element, since all operat- conditions within the head are visible. equipment may be driven by motor, gas engine, or from any belt con- ion to available revolutions per min- *—Chem-Feeds, Inc., Z7 Reservoir ., Providence, R. I.*

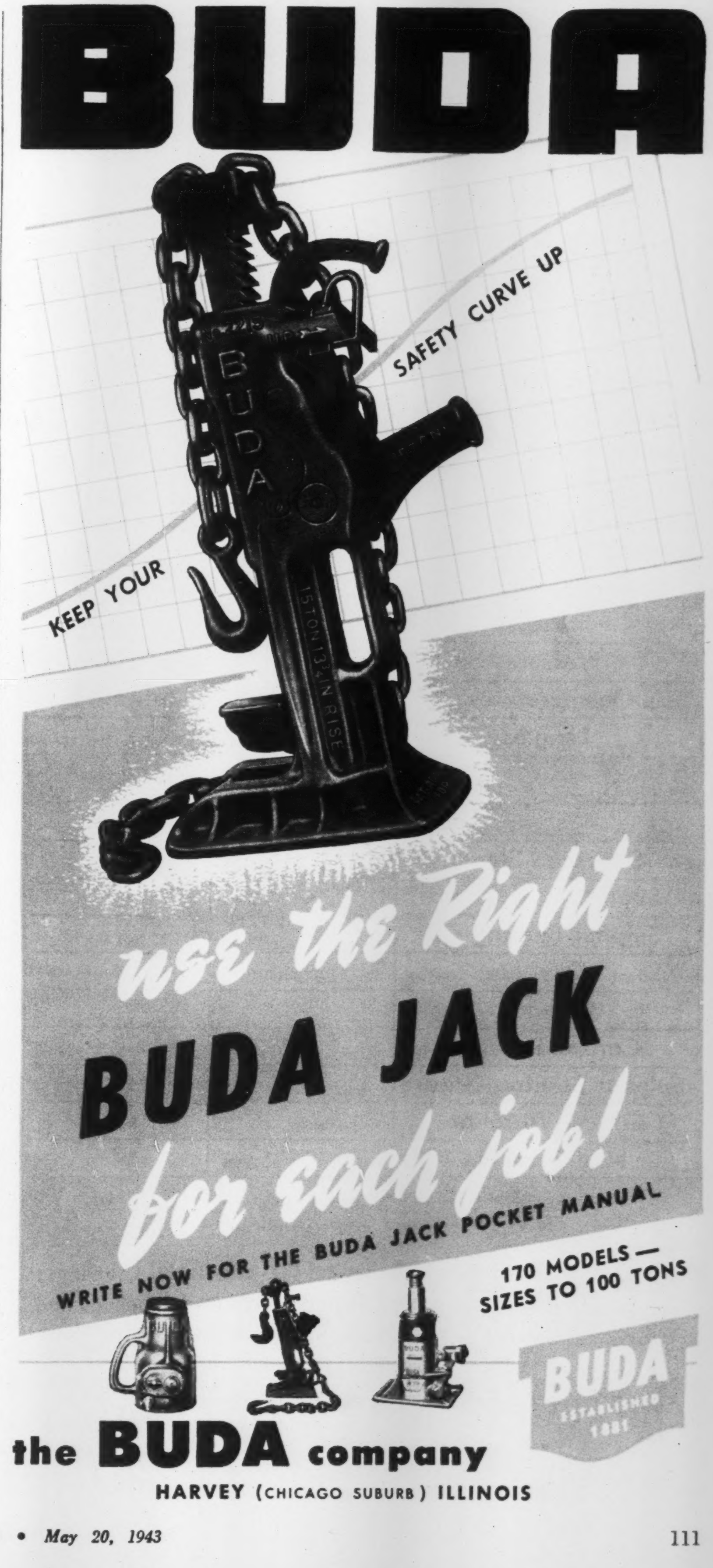


Rebuilt Water Wheels

he illustration shows an example of an obsolete water wheel can be dernized and rebuilt to give more er. This is one of two 54-in. water eels which were modernized recently Lincoln, N. H.; in this case new ners were cast in one section. The cast iron cases were rebored and ipped with new bronze gates and ler thrust and radial bearings. The ult was over a 20 percent increase in wer, and the elimination of constant uble and maintenance expense be- se the old thrust bearings did not p the runner in place. The manu- turer states that in many similar re- deling jobs it has been possible to ain power savings sufficient to pay the cost of modernization in a short e.—*Rodney Hunt Machine Co., Or- ge, Mass.*

New Plastic Drill

The plastic used in a new electric ll has special toughness and high im- ct strength. It is a cellulose acetate tyrate product. It is said to have cellent dimensional stability, and it


BUDA
KEEP YOUR
SAFETY CURVE UP
BUDA
15 TON 13¾ IN RISE
use the Right
BUDA JACK
for each job!
WRITE NOW FOR THE BUDA JACK POCKET MANUAL
170 MODELS —
SIZES TO 100 TONS
BUDA
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HARVEY (CHICAGO SUBURB) ILLINOIS

FLEXPEDITE

Your Conversion—Assembly—Production

with

REX-WELD

Flexible Metal Hose

Rex-Weld Hose—Annular Corrugations   Rex-Weld Hose—Helical Corrugations

RW-80 Unbraided—RW-81 Braided   RW-90 Unbraided—RW-91 Braided

—General Data—

	STEEL	BRONZE
Sizes	To 4" I.D.	To 4" I.D.
Pressures	To 14,500 p.s.i.	To 14,500 p.s.i.
Temperatures	To 1000° F	To 450° F.
Lengths	To 50'	To 50'

—Use Chart—

	*STEEL	BRONZE
Saturated Steam		✓
Superheated Steam	✓	
Sulphur Bearing Oil	✓	
Oxygen		✓
Ammonia	✓	
Carbon Dioxide	✓	
Sulphur Bearing Grease	✓	
Critical Vibration		✓
Non-Sparking		✓

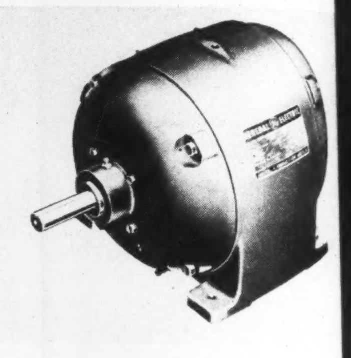
*Protective Coatings Can Be Applied for Corrosion Protection (To Conserve Critical Copper Bearing Alloys).

Couplings: REX-TITE Mechanical (Re-attachable) Couplings; Solder Couplings; Brazed and Welded Couplings and Flange Assemblies for Rex-Weld Flexible Metal Hose.

Ask for Engineering Recommendations

CHICAGO METAL HOSE CORPORATION
General Offices: MAYWOOD, ILLINOIS
Factories: Maywood and Elgin, Ill.

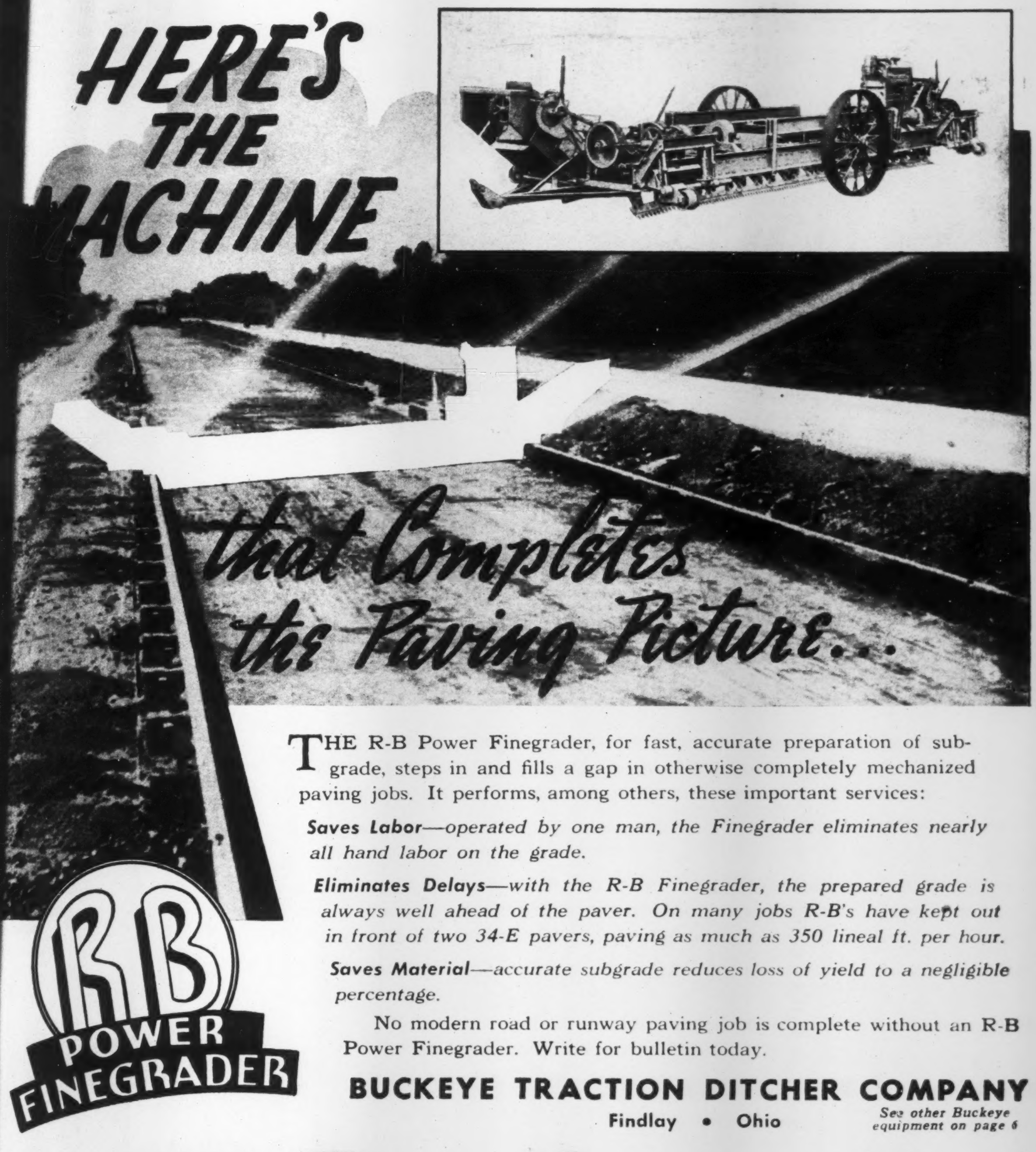
resists shrinkage and distortion un varying conditions of temperature humidity. It approaches the charac istics of metal with definite mel point. Because of the lightness of plastic, this new tool is 14 percent ligh than comparably rated heavy product ¼ in. capacity old-style electric dri Nearly two pounds of critical alumin is saved in each drill by use of pla for the housing, which is made in th parts—gear case, field case and han Compact and lighter, this plastic d still does not sacrifice anything in mo size and it has more power per pou The plastic is used as protective arm The plastic housing does not supp any of the operating parts of the too It acts simply as a tough shell. Intern parts of the drill are mounted in skeleton motor and rear frame to fo an independent, self-contained unit. Th construction assures close tolerance a permanent alignment of all parts, mo ing and stationary. The housing h extremely low conductivity to heat a electricity. The drill is cool to the touc cool-running and safe to operate. The are the claims of the manufacturer. *Independent Pneumatic Tool Co., 600 Jackson Boulevard, Chicago, Ill.*



Inclosed Tri-Clad Motors

A new line of totally inclosed motors has been announced. Available in both the polyphase, 60-cycle, induction type and the single-phase, 60-cycle, capacitor type, the new motors are especially designed for use under conditions where abrasives, chemicals, rain, snow and excessive dirt are encountered.

These new motors include the basic features of protection against physical damage, electrical breakdown, and normal operating wear and tear. In addition, all parts of the motor inclosure —frame, end shields, and conduit boxes —are cast iron, thus offering exceptional resistance to rust, corrosion, accidental blows and rough usage. Also, the leads are permanently encased in compound in a cast-in pocket in the stator frame, thus preventing liquids from seeping into the motor. Still further protection



THE R-B Power Finegrader, for fast, accurate preparation of subgrade, steps in and fills a gap in otherwise completely mechanized paving jobs. It performs, among others, these important services:

Saves Labor—*operated by one man, the Finegrader eliminates nearly all hand labor on the grade.*

Eliminates Delays—*with the R-B Finegrader, the prepared grade is always well ahead of the paver. On many jobs R-B's have kept out in front of two 34-E pavers, paving as much as 350 lineal ft. per hour.*

Saves Material—*accurate subgrade reduces loss of yield to a negligible percentage.*

No modern road or runway paving job is complete without an R-B Power Finegrader. Write for bulletin today.

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See other Buckeye equipment on page 6

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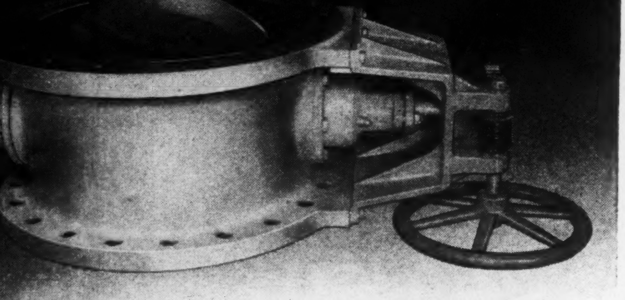
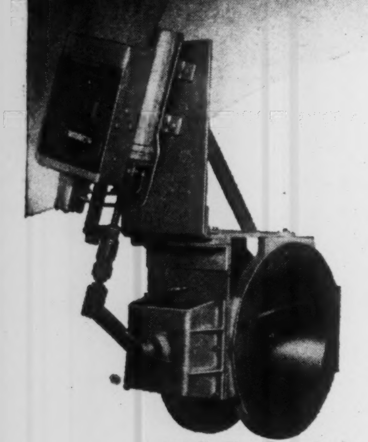
Service Duration Tripled with R-S BUTTERFLY VALVES



125 lb. Butterfly Valve with hand wheel control. American Standard flanges.



150 lb. Class B steel valve with automatic controller.

R-S QUALITY PRODUCTS SINCE 1908

15 to 900 psi

THE CASE HISTORY of a 6-inch, 125 lb. R-S Butterfly Valve illustrates the advantages and increased service to be obtained from this type valve. It was installed in a line leading to a condenser and used for shut-off under 70 lbs. pressure.

Previous installations of conventional type valves did not hold up and had to be replaced *every six to eight months* as the abrasive action of the fluid in the form of a high pressure "jet" wore a hole through the casing. When an R-S Butterfly Valve with "A" Metal was installed, the length of service was tripled.

Here is concrete evidence that even abrasive materials "fan out" into a crescent-shaped spray when the Butterfly Vane approaches a closed position. This fact, coupled with the use of "A" Metal in an R-S Butterfly Valve, produces outstanding results where hard wear and severe stresses are encountered.

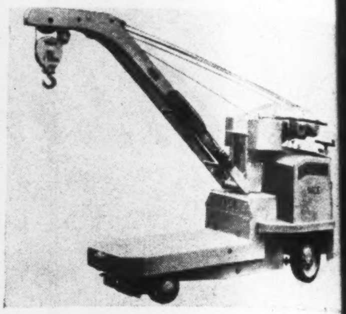
The Butterfly Vane is not a "flopper." It is beveled and wedges against the valve body when closed. Compare—results prove the superior efficiency of this type valve under high or low pressures and temperatures.

Your R-S Distributor will gladly furnish detailed information.

VALVE DIVISION
R-S PRODUCTS CORPORATION
116 Berkley Street Philadelphia, Penna.

R-S Streamlined BUTTERFLY VALVES

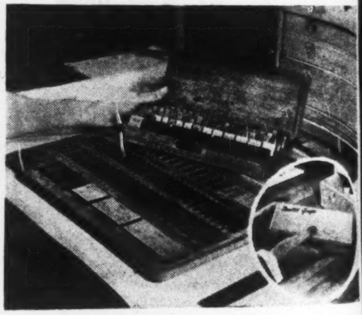
is provided in the form of a rotati labyrinth seal, which prevents dirt, or water from entering the bearing ho ing.—*Motor Div., General Electric C Schenectady, N. Y.*



Materials Handling Crane

A 6,000-lb. capacity, low, elevatin platform truck combined with a 2,000-l capacity twin-unit crane, provide a tw in-one materials handling unit that a sures greater efficiency and flexibility i materials handling operations, accordin to the manufacturer. Electrically powered with four speeds forward and reverse, this new truck incorporates in it construction features late engineerin advancements such as—compact, smal overall dimensions for maximum maneuverability in close quarters, plus greate visibility and safety for the operator.

A winch unit supplies the hoisting an booming power and they can be operated simultaneously through separate push button crane and hoist controls. Separate, independent motors and power units drive the truck for travel as wel as to hoist and boom the load. In addition, slewing is efficiently controlled b hand. Push button contractor controls assure accurate spotting of loads.—*The Yale & Towne Mfg. Co., Philadelphia Division, Philadelphia, Pa.*



Case for Gage Blocks

Heretofore, gage blocks have been kept in a large case in which the blocks are placed flat in recesses. This has often necessitated a cumbersome box particularly for the standard set of 8 blocks. The new case is designed

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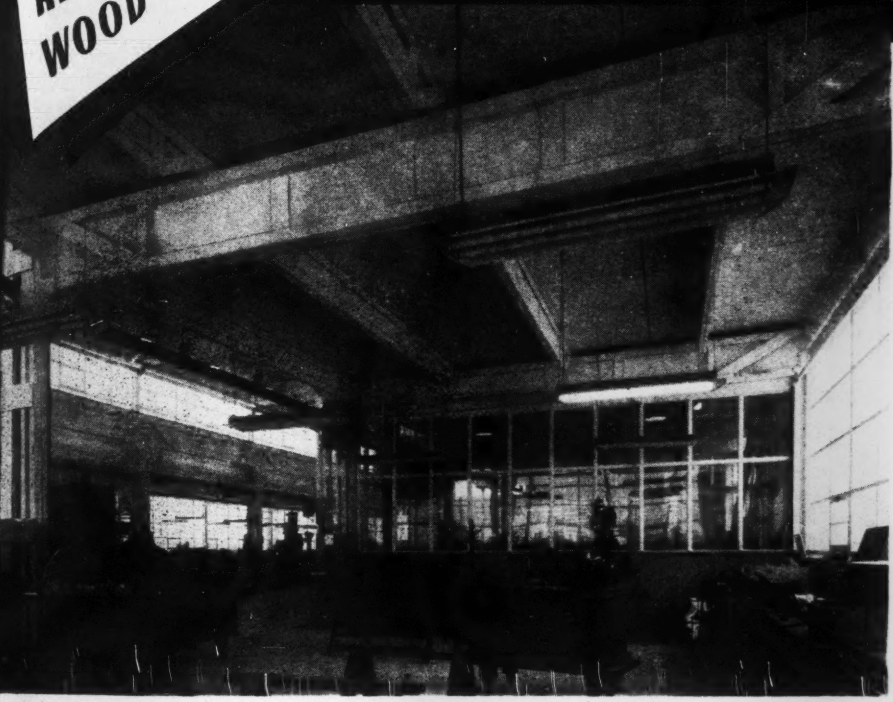

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TIMBEAM affords a timely means of effecting a mendous saving of lumber, now an extremely itical material. In fact, TIMBEAMS make the use conventional solid wood members for structural ming an extravagance and waste, because TIM-EAMS generally save one-half or more of the lumber required for solid sections of equivalent strength.

TIMBEAMS are I-shaped wood fabrications which o not require stress grade lumber. Due to the fact at they are made of plywood and standard dimension lumber, inventories of which are maintained, also that TIMBEAMS are shop-fabricated to size and length and are placed directly into position on the job, prompt delivery and the shortest completion schedules are assured.

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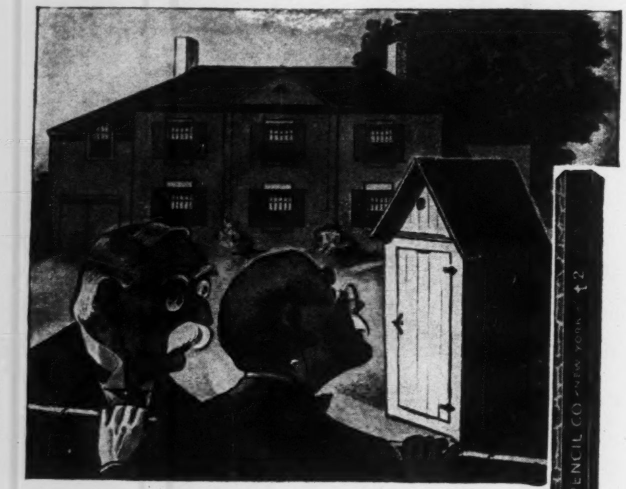

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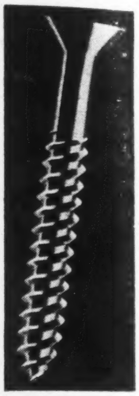
that it is only one-fourth as large a conventional type, yet it holds th precision gages in full view of the All standard sets of gage blocks wi supplied in this new case, although conventional flat type box may stil obtained for those having special for it—*Savage Tool Co., Savage, W*



Twin Thread Screw

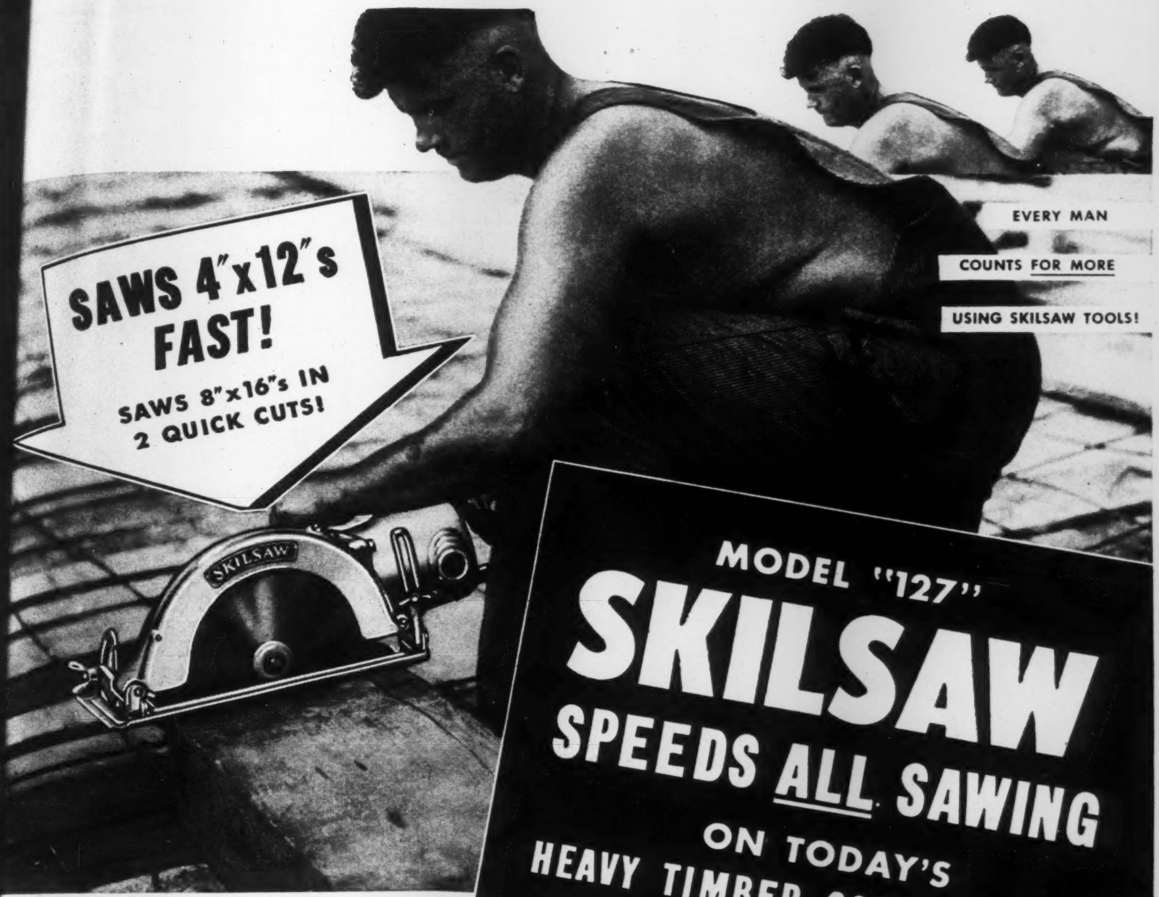
A new patented screw for wood, pla and combination assemblies has j been introduced. The screw has parallel threads which start at oppo sides of the shank and terminate i single centered point. The twin-thre construction affords a greater thre pitch than the conventional screw, that the driving speed is doubled. the driving torque is only nominal, si the twin-thread construction provides t standard number of threads per in The screws are self-tapping, cutting th own clean full threads. The screw cylindrical. This gives it greater streng The thread area is increased, providi more extensive contact, tighter seati and greater holding power than w tapered screws.—*Blake & Johnson C Waterville, Conn.*

A Safety Wrench

B. Hart of Vancouver, B. C., has be issued letters patent for a safety wren designed to reduce the number of indu trial accidents caused by slipping a spreading wrenches. The new saf wrench will remain on the nut during t whole process of wrenching, if nec sary, and therefore will not slip.—*Hart, 1353 Maple St., Vancouver, B.*

Flexible Controls

Remote control systems which ready have been installed in the mar field for the control of ships are n made available to the general constr tion field. They are being used on pow shovels in the earth-moving indust and in the mining, petroleum and m chine tool industries.—*Westinghouse Brake Co., Pittsburgh, Pa.*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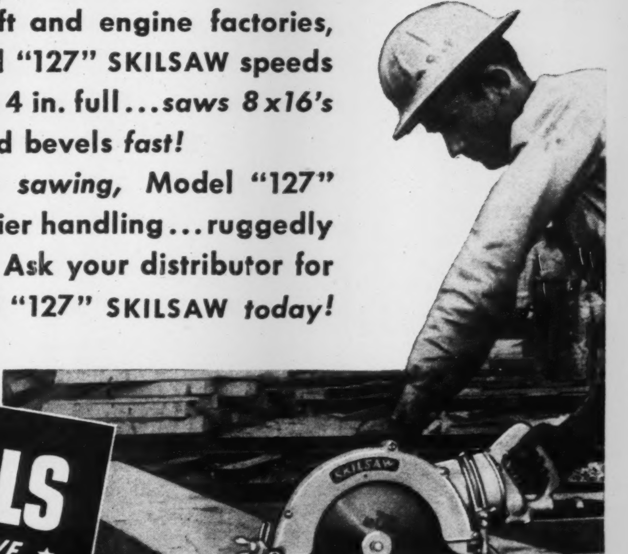

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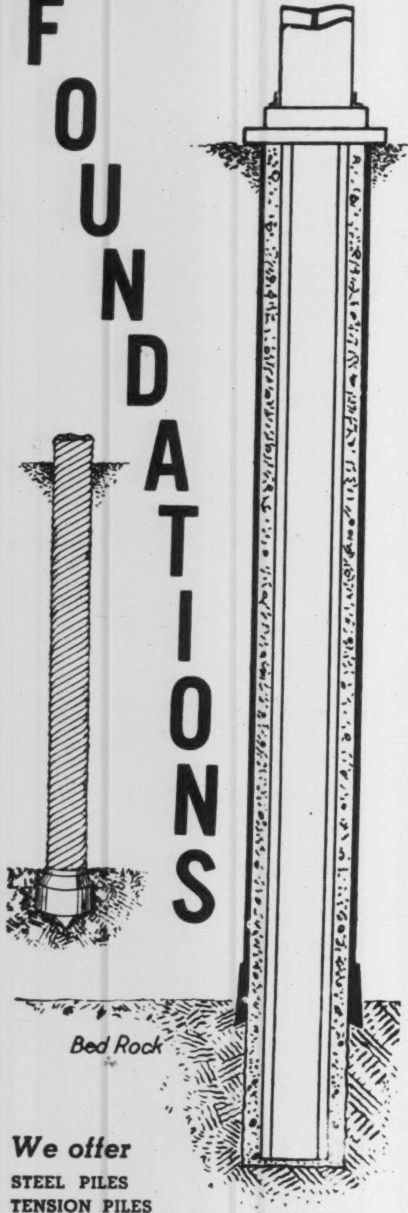

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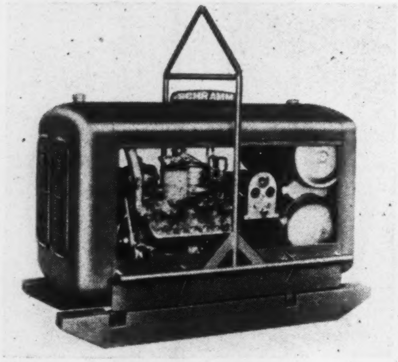

Easily Handled Compressor

Because of light-weight and compactness of the skidded model compressor, it lends itself to many possibilities. The illustration shows the special skidded outfit and is a good example of what can be done with a unit of this type. With a shifting bale, the outfit can easily be moved about with crane, chain hoists and other power units. In addition there are side handles, welded to the frame, for lifting by man power, when hoisting equipment is not available, for loading and unloading purposes. Other special features include oil filter on engine, gas tank lockable filler cap, at slight additional cost. Spring shackles are included at no additional cost and can be used for conversion to a two wheel outfit when desired.—*Schramm, Inc., West Chester, Pa.*

Rust Prevention Paint

A nature-compounded mineral is being used as the pigment for a rust preventive paint now on the market. It is claimed that the mineral produces a protective film for exposed surfaces which defies weather extremes, light, heat, gases, alkalies, sea water and acids. It inhibits electrolysis and corrosion.—*L. Sonneborn Sons, Inc., 88 Lexington Ave., New York, N. Y.*

Round Ventilators for Roofs

Among the special features claimed for this new ventilator are the following: Full stated dimensions, inside measurement for base ring of each size ventilator; stack height equal to stack diameter, which facilitates air flow through the vent head; wind baffle designed to prevent wind from entering accelerator band; accelerator band of oversize diameter and height. Weather baffle, giving maximum unobstructed ventilator exhaust and assuring weather-tight protection; cone of adequate pitch for drainage, and diameter to assure weathertight ventilator under the most severe conditions; frame structure designed for wind of 80 mph.—*American Steel Band Co., Pittsburgh, Pa.*

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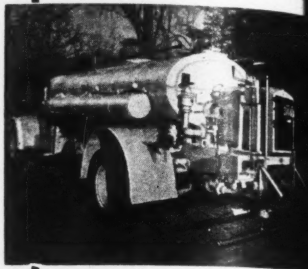

We're sorry that the urgent requirements of war production prevent our accepting orders now for Kinney Bituminous Distributors. When the war is won, these reliable distributors . . . well known for 33 years . . . will again be available, designed for new road building methods and with further improvements for most efficient and economical operation. Plan now for the future . . . and remember KINNEY.

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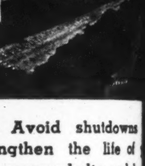

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FLEXCO H D RIP PLATES are used in repairing rips and patching conveyor belts. Their use saves expensive replacements and extended shutdowns.

FLEXCO H D BELT FASTENERS make a strong, tight butt joint with long life. Recessed plates embed in belt, compress belt ends and prevent ply separation. Six sizes in steel and alloys.

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ere, deep below the surface, im- rsed in a constant bath of corrosive water, lay the steel pipe of a water pply line. That pipe, HOT-DIP LVANIZED before it was laid in 2, is still in good condition after years of uninterrupted service! T-DIP GALVANIZING gave it thickest possible coating of pro- tive zinc, and saved the taxpayers large sums of money in maintenance and replacement expense. There are other methods of galvanizing, but only HOT-DIP GALVANIZING provides a thick zinc coating fused inseparably to the metal beneath—the most economic rust protection known to modern science. American Hot Dip Galvanizers Association, Inc., First National Bank Bldg., Pittsburgh, Pa.

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W. M. WOOD, of Decatur, Ill., years president of the Mississippi Structural Steel Co., has been e chairman of the board, and R. D. of Chicago, Ill., has been elected dent. W. M. Wood, one of the fou of the company, served as treasure chief engineer until his election presidency in 1918. He is a directo member of the executive committ the American Institute of Steel Co

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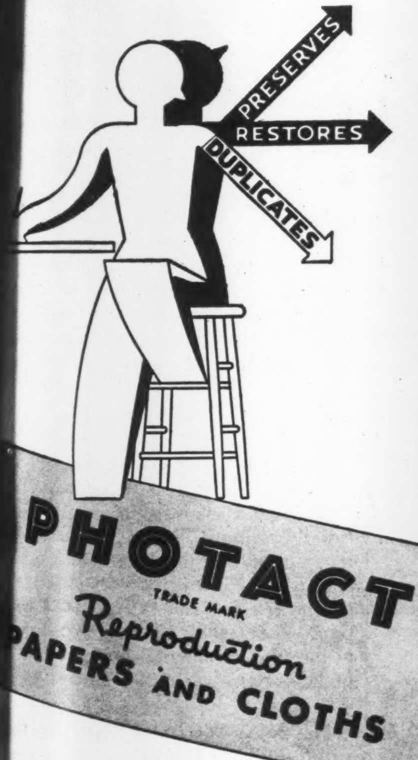

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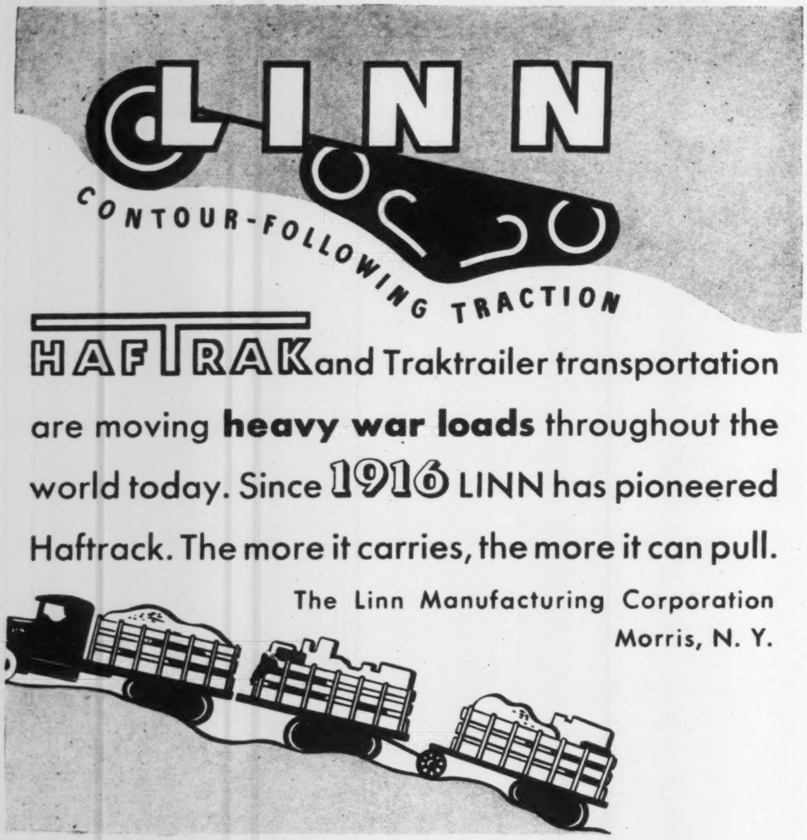

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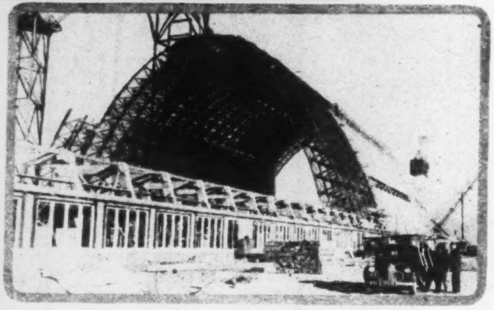

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Decatur, Ill., and a director of the
nois Manufacturers Association. R.
Wood, who succeeds his brother as p
dent, came to the company in 1906
lowing his graduation from Cornell
versity, and for the past 20 years
been a vice-president.

T. M. Cummings has been appoin
executive vice president and gen
manager of the Progressive Welder
Detroit, Mich. Mr. Cummings, who
been vice president of Progressive si
the company was founded, atten
Bucknell University and obtained
early experience in resistance weld
in the automotive industry. In 1933
helped organize the company and for
first year was in charge of manufact
ing and engineering development. W
manufacturing and engineering divis
organized, Mr. Cummings was placed
charge of sales development for
company.

Henry A. Denny, contract engine
Koppers Co., engineering and constr
tion division, has been appoin
assistant superintendent of constructi
Denny has served Koppers Co. as fi
engineer and erecting engineer and
in Haifa, Palestine, with the M. W. K
logg Co. of New York.

Award of the company's 50 year med
to L. N. Aller, secretary-treasur
brought to fifteen the number of m
now living who have been employed
the Taylor-Wharton Iron & Steel Co.
High Bridge, N. J., for 50 years or mo
Organized in 1917 on the occasion of t
company's 175th anniversary, the 50-ye
club has had a total of 42 members.
the fifteen now living, eleven are st
in the employ of the company while t
other four have retired. Mr. Aller start
working for the company as a tim
keeper at $3 a week when he was 16 yea
old. After going through various depa
ments he became assistant treasurer a
was made secretary and treasurer
1930.

Three executive promotions have be
announced by the SKF Industries, Inc
Philadelphia manufacturers of ball a
roller bearings. **Thomas W. Dinlock**
was elected vice-president and treasure
Richard H. Demott vice-president
charge of sales, and **C. P. Collins**, secr
tary. **William L. Batt**, vice-chairm
of the War Production Board, retains t
presidency.

Henry N. Armbrust is now associat
with Builders-Providence, Providen
R. I. Mr. Armbrust will serve as a

UT NEW POWER INTO THE OLD WAR HORSE

se "war horses" have been pulling hard now for e than a year . . . for the seventeen months of dy, all-out production since Pearl Harbor.

eady many Diesels are beginning to show signs of ain. Longer hours of operation, less frequent overls, fewer replacements—all have increased the ard of breakdown a hundredfold.

re's one way, even at this late hour, to help keep r Diesel geared for steady, smooth, efficient action . *Make sure that you're servicing it with cision-Perfect Lubricants!*

ities Service D-C 500 Series Oils for high-speed omotive type Diesels . . . and Pacemaker or Pennemaker Series oils for stationary type Diesels . . . designed to meet the most exacting demands of time operation.

If you want to be sure you're getting the most out of your Diesels, let a Cities Service engineer study your particular operation. No obligation, of course. Simply get in touch with your nearest Cities Service office today.

For a helpful booklet on "Diesel Engine Lubrication," write to Room 1371. Sixty Wall Tower, New York, N. Y. Free to owners of Diesel engines and their personnel.

Maumelle Ordnance Works
Cities Service Defense
Corporation

OIL IS AMMUNITION—USE IT WISELY!

CITIES SERVICE OIL COMPANY
NEW YORK • CHICAGO

IN THE SOUTH
ARKANSAS FUEL OIL COMPANY
SHREVEPORT, LA.

IN SE
HOME
AD

FOR MORE THAN [illegible] YEARS McCracken Concrete Pipe Machines have helped solve sanitation problems and have contributed to industrial progress all over the Western Hemisphere. Today there are [illegible] McCracken plants in the United States and [illegible] plants in Latin America.

McCRACKEN Machines Make: Soil Pipe—Drain Tile—Culvert Pipe—Conduit. Either plain or reinforced. 4" thru to 36".

1. At the Highest Speed
2. Of the Highest Quality
3. At the Lowest Cost
4. In Any Location

McCRACKEN PIPE

Corrugated

CONCRETE PIPE MACHINERY CO.
• Sioux City, Iowa, U.S.A.

search engineer and in this capacity will have a leading part in the company's market and product research program. He is a graduate of Rhode Island State College, and during the past few years he has made a number of original contributions in the water and sewerage works field.

A SPECIALIST for over 36 years in the construction and installation of street lighting standards, Donald C. Barrick died recently at Cleveland, O. He was 59 years old. Mr. Barrick had been associated with the Union Metal Mfg. Co., Canton, Ohio, almost continuously since he and his father, C. C. Ballick, founded the company in 1906. He was responsible for many outstanding street lighting installations throughout the country, and was well known to municipal and utility officials.

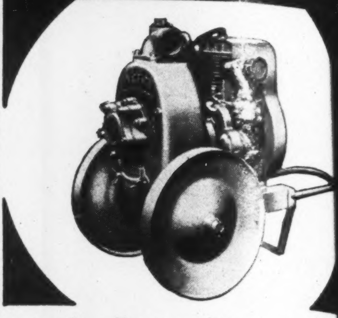
During the past 15 months a total of 630,000 potential civilian truck sales have accumulated for peacetime business, according to F. F. STANIFORD, sales manager of Mack Trucks, Inc. Basing his estimate on an average of 44,500 truck sales per month during the years 1937 to 1941, inclusive, Mr. Staniford subtracted the civilian truck sales made during 1942 to arrive at his total. Roughly, six out of every 100 normal truck requests have been met in the past year, and this ratio is expected to hold for the duration of the war.

WALTER E. POOR, executive vice president, has been elected president of Sylvania Electric Products, Inc., succeeding B. G. Erskine, now chairman of the board. Noel E. Keeler, controller and assistant treasurer, has been made treasurer, and Philip P. Borden has been named assistant treasurer. Mr. Poor has been a director of the company since its incorporation under the Hygrade name in 1917, concerning himself largely with engineering and research. Mr. Keeler was formerly treasurer and controller of the American Blower Co. New directors elected are W. J. Wardall, C. F. Hockley, D. G. Mitchell, N. E. Keeler, R. M. Wise and E. F. Carter.

THE NATIONAL ASSOCIATION OF MANUFACTURERS has announced the election to its board of directors of HOWARD F. STOVER, of Tulsa, Okla., secretary-treasurer of the Gaso Pump & Burner Mfg. Co.

PRESIDENT CHARLES R. HOOK, of the American Rolling Mill Co., Middletown, Ohio, has announced the election of Frederick V. Geir, president of the Cincinnati Milling Machine Co., as a director.

JAEGER "SURE PRIME



—the Pumps that excee
their promises

with up to 5 times faster priming, wit
hi-head, hi-capacity performance, wit
thousands of extra hours c
trouble-free service.

Self-cleaning design, re-
placeable liners, longest lif
seal, heavy duty construc-
tion thruout.

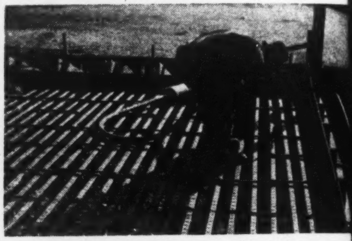
Every unit individually tested
and certified — you know
you're getting the best.

Sizes 3000 to over 200,000 G.P.H.

52 Lb. Bantam
—3000 G.P.H.

THE JAEGER MACHINE CO.
200 Dublin Ave., Columbus, Ohi

NEW—JUST OUT



HOW TO SPEED
CONCRETE WORK
WITH VIBER VIBRATION

Completely illustrates and describes our new an improved line of Viber Vibrators for gas, electric and air-operation. These are the Vibrators wi completely interchangeable parts that are speed ing war work everywhere.

• FLEXIBLE PNEUMATIC VIBRATOR
Made in 2⅛" and 3" diameter with 12 ft. and 21 ft. flexible shaft. Complete interchangeability of flexible casings, cores, vibrators. Operates on 80 lbs. pressure

• Write New Catalog will be promptly sent on request. Write for it today.

VIBER COMPANY
726 SO. FLOWER STREET
BURBANK, CALIFORNIA

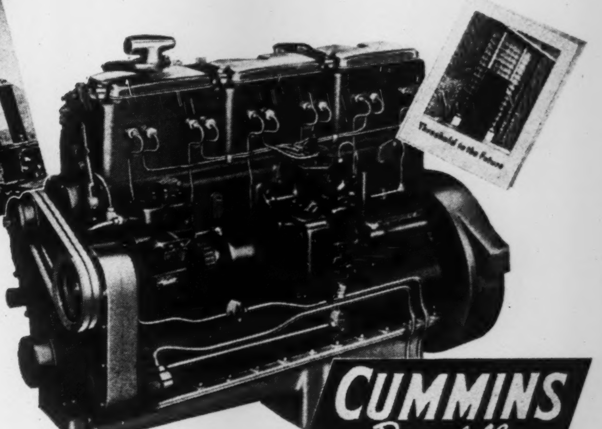
At its best . . . when the going is Tough

The first Cummins high-speed Diesel was offered to the public in 1932. From that day to this, the Cummins Diesel has never asked for the easy jobs . . . but has consistently proved itself in the face of the longest odds . . . on the toughest, the longest and the hardest pulls . . . on the jobs which demand the delivery of an engine's full rated horsepower day after day.

Now, after a decade of conditioning, the Cummins Diesel is ready for action—*is in action*—on every front in this global war. Its quick starting has been tested in the sub-zero arctic cold. Its cool running has been demonstrated in flaming desert heat. Its simple, easy service and maintenance has been proved in the world's most inaccessible, out-of-the-way places.

In short, the Cummins Diesel has proved its ability to uphold the highest American tradition . . . to do its best job when the going is toughest. CUMMINS ENGINE COMPANY, Columbus, Indiana.

Out of the experiences of owners during the past 10 years—plus new tests which the engine is meeting daily—a newer and better Cummins Diesel is now building . . . one which will do your job at a lower cost, for a longer time, with fewer parts replacements and service requirements. When all-over economy again becomes the yardstick of value, this new Cummins Diesel will be your first choice. The new booklet, "Threshold to the Future" will tell you why. Ask for your copy.



CUMMINS
Dependable
DIESELS

BROTHER, THIS IS WAR!

War Drawings Are Extremely Valuable!
Assure Their Permanence – Use

ARKWRIGHT TRACING CLOTHS!

Here are two advantages of Arkwright Tracing Cloths – especially important if you're producing war drawings! First, Arkwright Tracing Cloths don't become brittle or opaque – don't lose the high transparency needed to make sharp, accurate transfers – even when filed away for years. Second, Arkwright Tracing Cloths can be run through blueprint machines time after time without tearing, fraying, or curling. Safeguard all war drawings – use Arkwright Tracing Cloths. Arkwright Finishing Company, Providence, R. I.

Arkwright TRACING CLOTHS
AMERICA'S STANDARD FOR OVER 20 YEARS

SPARLING
MAIN-LINE WATER METERS
"Accurate Main-Line Measurement Pays"

And that's just a reminder of something you already know! Install Sparling Water Measuring Equipment for consistent accuracy.

Bulletin 308 will be sent upon request.

R. W. SPARLING

Box 3277 Terminal Annex.................LOS ANGELES
3104 South Michigan Ave.......................CHICAGO
622 Broadway ....CINCINNATI
101 Park Avenue..............................NEW YORK
6 Beacon Street..................................BOSTON

NEW
TRADE PUBLICATIONS

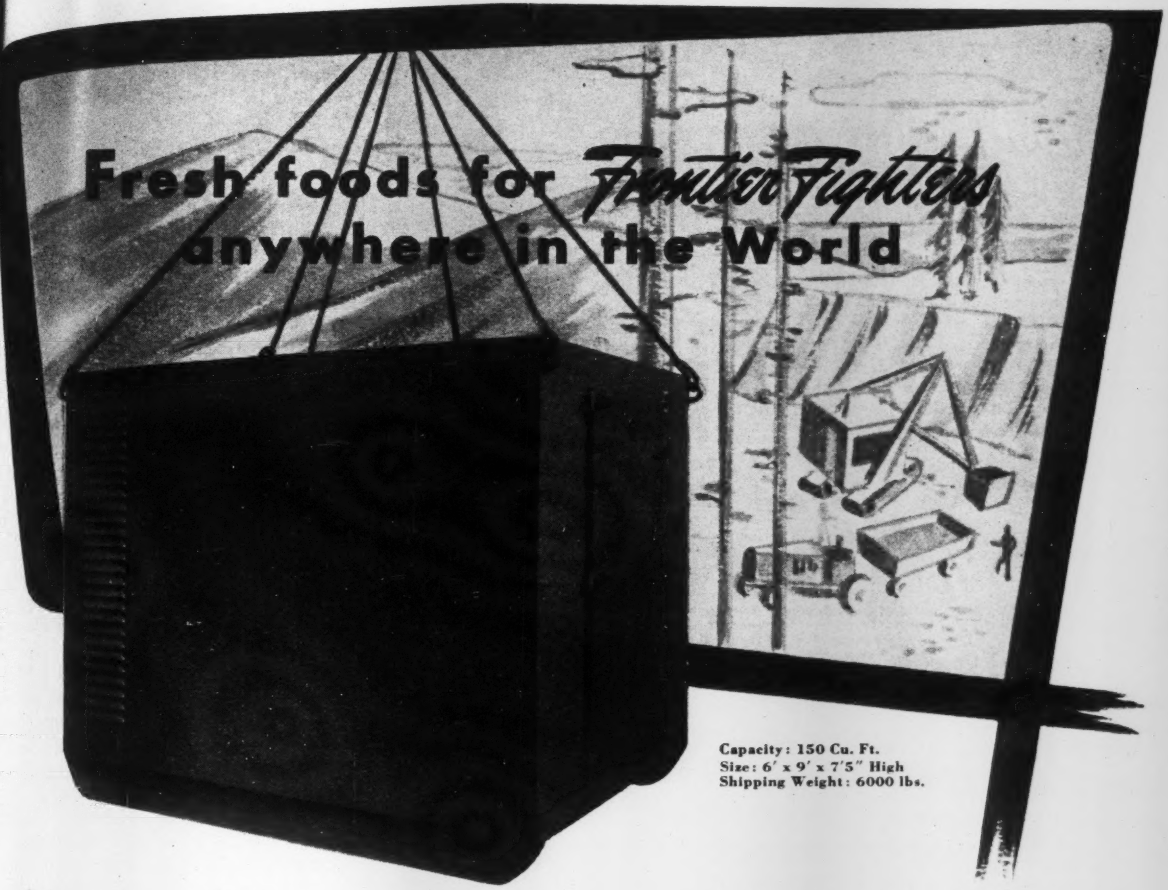
Dividends from the Power Plant—A 48-page booklet written so that managers without extensive engineering training can understand the principles governing the economical operation of steam-generating equipment has been issued. The booklet discusses: importance of boiler efficiency, the relation between steam costs and profits, natural versus mechanical draft, carbon dioxide and carbon monoxide, excess air, and factors that govern labor costs in the boiler room. The text has examples, tables and sketches to make each topic clear.—*Preferred Utilities Co. Inc., 33 West 60th St., New York City.*

Fire Extinguisher Charts—Two new fire extinguisher charts show the operating characteristics of first aid hand fire extinguishers and wheeled engines. The charts clearly and concisely tabulate several types, and their suitability or otherwise as applying to Class "A," "B" and "C" fires, in accordance with Underwriters Laboratories' classification. For convenience, a Class "D" is added to cover the fire hazards of automobiles, commercial trucks, etc., and a Class "DT" to cover the fire risks pertaining to tank-trucks and trailer-tractors.—*American LaFrance-Foamite Corp., Elmira, N. Y.*

Variable Speed Drives—"The Graham Dial" is a convenient monthly abstract of interesting articles from the technical press, together with timely news about variable speed drives which is put out by —*Graham Transmission, Inc., Milwaukee, Wis.*

Scale and Corrosion Control—The new fifth edition of the D. W. Haering & Company booklet on "Organic Methods of Scale and Corrosion Control," tests on the use of organic chemicals in water treating, is just off the press. This 28-page discussion of organic methods presents the latest information on scale and corrosion control. There are a number of charts, graphs, tables and photographs to illustrate the usefulness of organic chemicals in water conditioning. In addition to the discussion of organic chemicals, the new edition includes an explanation and causes of scale and cor-

Fresh foods for *Frontier Fighters* anywhere in the World



Capacity: 150 Cu. Ft.
Size: 6′ x 9′ x 7′5″ High
Shipping Weight: 6000 lbs.

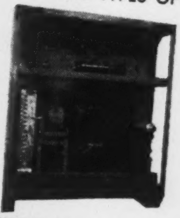
IN THIS world-wide war many thousands of men are working and fighting in out-of-the-way places all over the globe. Places far out of the *normal* reach of facilities for feeding them. In sweltering, uninhabited jungles on far-flung Pacific isles, and in lonely outposts of the arctic regions these men, our *frontier fighters*, must be fed. Getting fresh food to them and keeping it fresh involves no small problem of refrigeration.

It was in answer to this problem that Weber facilities and experience developed the lift refrigerator. An easily convertible freezing unit that operates continuously while en route on either gasoline or electric power, A.C. or D.C. current.

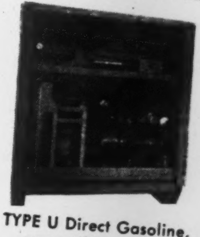
In the hold of a cargo vessel it operates on the available electric power, or if in transit by truck it keeps food at a uniform low temperature under gasoline power. To be put in operation either way it requires no refrigeration expert . . . no technical knowledge whatever is needed. A 10° temperature can be maintained in a 110° ambient temperature for frozen foods or it can be set at 35° with a 100° temperature differential. If yours is a refrigeration or other special manufacturing problem pertaining to the war effort Weber facilities are available. Our representative will gladly discuss it with your engineering staff. Write or wire today.

WEBER SHOWCASE & FIXTURE CO. INC.
5700 AVALON BOULEVARD · LOS ANGELES, CALIFORNIA

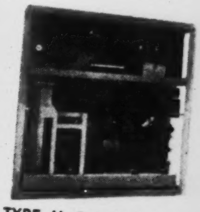
THREE TYPES OF POWER EQUIPMENT TO MEET WORLD-WIDE NEEDS



TYPE B Direct Gasoline engine power operated.



TYPE U Direct Gasoline, convertible to A.C.



TYPE H Gasoline powered electric A.C. or D.C.

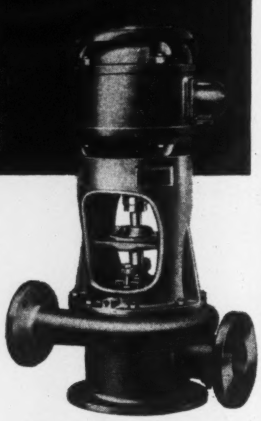
WEBER

EST. 1898

WEBER FACILITIES & EXPERIENCE "WORKING FOR VICTORY"

ARMY E NAVY

The Pump DESIGNED AND BUILT TO MEET TODAY'S DEMANDS



The new Economy SCV pump is adaptable to almost any pumping job where clear water or liquids are handled. Vertical in design—it saves space and places motor high and dry above its mounting surface. It is built with the stamina to do the job—no costly pump failures to disrupt schedules. For services from 10 to 500 G.P.M. with heads up to 225 Feet. Write for Catalog D2-1042 which fully describes and illustrates the SCV pump.

Free!

Economy's latest Pump Data Book. Contains a wealth of data and supplies information for the solution of most pumping problems. Written in simplified form—easily understood by anyone interested in pumps. Get your copy now—simply send your request on company's letterhead.

- **Easy to install—low operating cost — minimum maintenance requirements.**
- **Complete rotor, including motor, can be removed without disturbing the suction and discharge connections.**
- **No costly shutdowns — in the event of motor failure any comparable stock motor is easily adapted.**
- **Impeller runs smoothly between two bearings—no shaft whip—no noise.**

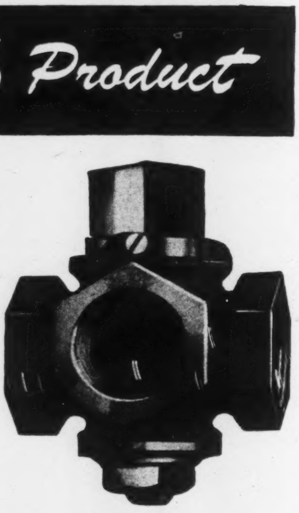
Economy Pumps Inc,
HAMILTON, OHIO

Another HAYS *Product*

3-WAY STOPS

This 3-Way Stop is made with either 3 port or 2 port plugs.

- Originally designed for water or gas, this 3-Way Stop is another Hays product that is finding new uses never thought of before the war. It permits directing flow of liquids or gases as desired and is finding many Marine applications. What size can you use?



★ **Fig. 291 B—3 Port.**
Fig. 291 BL—3 Port with wrench.
★ **Fig. 291 D—2 Port.**
Fig. 291 DL—2 Port with wrench.

Sizes ¼", ⅜", ½", ¾", 1", 1¼", 1½", 2".

HAYS MANUFACTURING CO., ERIE, PA. • SINCE 1869
HAYS *Piping Products*
FOR LIQUIDS, STEAM AND GASES

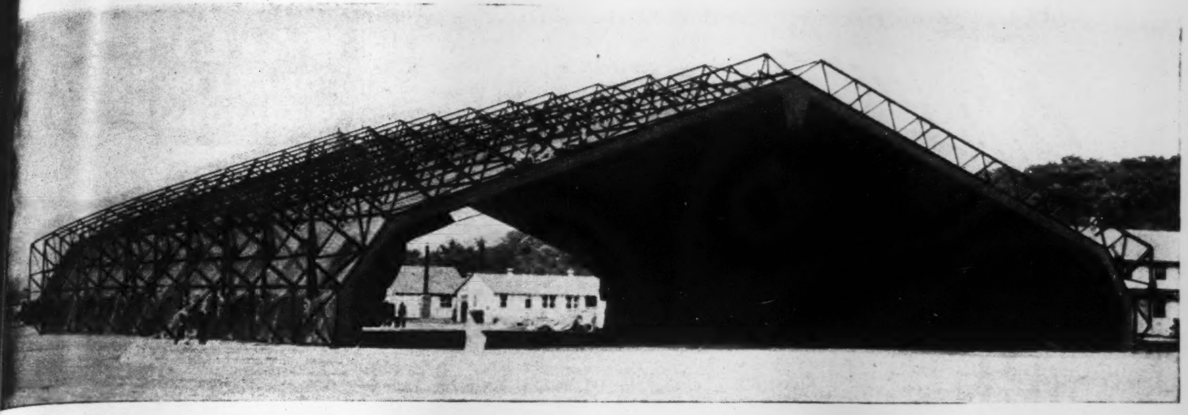
rosion and introduces a new section tabulating the physical and chemical properties of the various glucosates developed by the company's research.—*D. W. Haering & Co., Inc., 205 W. Wacker Drive, Chicago, Ill.*

Temperature and Humidity Control—A new condensed catalog listing equipment for temperature and humidity control, refrigeration, heating and ventilating has just been issued by the Carrier Corp. Contained in the 12-page booklet is information regarding applications, specifications, features and installation of 16 types of equipment grouped according to functional characteristics. A feature of the condensed catalog is a listing of 105 uses of the equipment in war production and also a chart that indicates services for postwar construction.—*Carrier Corp., Syracuse, N. Y.*

Engineers' Handbook—A catalog that gives specifications for roofing and siding, together with suggestions for estimating the materials required. It gives the application of the product for steel construction, wood construction, siding sheets, roofing sheets, eave flashing, ridge caps, box cable flashing, corrugated cable flashing, window flashing, corrugated side wall and counter flashings, corner flashing, strap fasteners, girt fasteners, and a variable table showing how to compute sheet covers.—*Protective Steel Products Co., Pittsburgh, Pa.*

Window Construction —Bar window construction represents an effort to produce as simply as possible a window construction with all the primary functions of a window—(1) To admit as much daylight as possible, (2) To exclude rain, snow, sleet, soot and other undesirable elements. (3) To deliver to the adjacent construction the wind stresses imposed on the window. (4) To provide ventilation. It is said that this bar system of fenestration provides along with the four primary functions, and with equal emphasis, the capacity to maintain them at a minimum of expense, not however, without a marked departure from old methods and procedure. All this and additional information is contained in a catalog just off the press.—*E. K. Geyser & Co.,* 200 *Cedarhurst St., Pittsburgh, Pa.*

Deaeration of Water—A comprehensive 36-page catalogue on treatment of tray-type deaerators, atomizing deaerators, deaerating hot water generators and cold water deaerators. Sections are devoted to: flow diagrams, including photographs of installations described; corrosion control; pH control; metering deaerating equipment with V-notch recorder



"NOW IT CAN BE TOLD"

Nests for War Birds in 12 Hours

Early in the war it became apparent that Butler could best serve our country by furnishing airplane hangars designed for erection and service under war conditions.

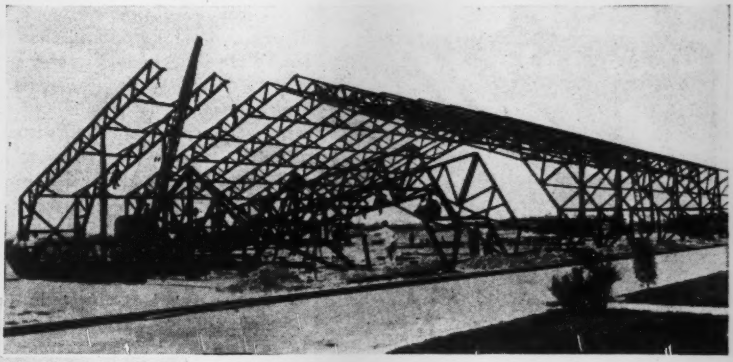
Butler's remarkable low hinged-arch steel covered hangar that has served our forces so well all over the globe, was a long step ahead of anything heretofore. But this was not enough.

As the war progressed steel became more and more critical and shipping space more and more valuable. In order to meet these new conditions and supply our fighting forces with the maximum hangar service, Butler engineers in colaboration with Army and Aviation Engineers developed the BUTLER COMBAT HANGAR.

The field proven advantages of the steel hinged arch design employed in the previous development were retained. However, due to the scarcity of hot rolled structural steel we adopted the use of ENGINEERED SHAPES, cold formed on high speed rolling machines from least critical flat strip steel stock. Members were proportioned to nest one inside the other to the extent that one cubic foot of shipping space equalled 226 cubic of hangar. This resulted in reducing shipping cubage to 1/10 of what was required for the arch type hangar. Maximum efficient sections were obtained, thus saving over 80 tons of precious steel and all bundles were adapted for air transport. A clever combination drift pin bolt was designed for field connection, making possible the rapid erection of complete hangar in less than 12 hours.

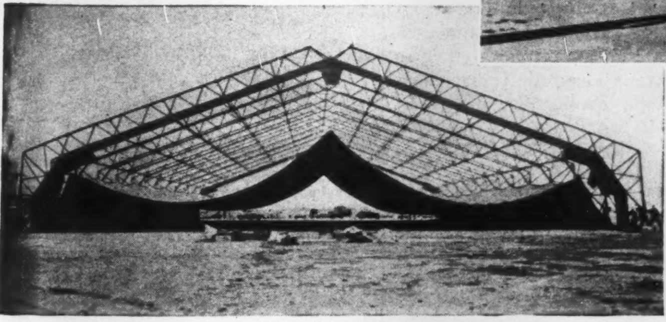
Fire and water resistant canvas was used as the enclosure element. Here again Engineering ingenuity stepped in by suspending the canvas envelope under the arch frame thru a series of rope and pulley arrangements so that complete envelope could be preassembled on the ground. A more permanent steel or wood roof can be applied without alteration at any time, and herein lies the peacetime possibilities in this unique development.

Erection of the Butler 3-hinged-arch hangar (130'x160'x39') is possible in 12 hours. A complete bay, half the hangar width, is assembled on the ground, bent bases are hinged to the steel bearing pads, the haunch sections connected and the bay section raised and rested on gin poles until the opposite bay section is similarly raised. Only the center connection at the peak of the truss need be made in the air. Steel rods tie across the hangar width from bent base to bent base. ➡



Instead of steel sheathing a flame-proof canvas envelope was designed to assemble like a circus tent and then to be raised and suspended beneath the steel structure on a system of ropes and pulleys. The three-hinged-arch steel frame will also carry conventional steel or wood roof on the upper chords of the trusses.

⬇



ARMY E NAVY

Awarded to Our
Kansas City Plant

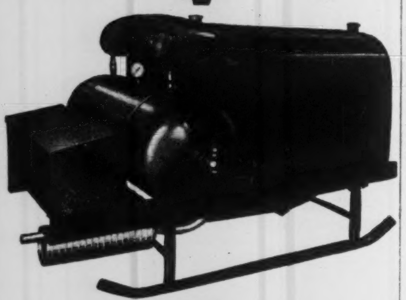
BUTLER MANUFACTURING COMPANY
KANSAS CITY, MO.
GALESBURG, ILL. MINNEAPOLIS, MINN.
Sales Offices: Washington, New York, Chicago, Atlanta and Shreveport

PRODUCING FOR WAR PLANNING FOR PEACE

BUTLER BUILT

STEEL BUILDINGS ... TANKS (Storage, Processing and Transport) ... FILTERS ... STILLS ... DRY CLEANING EQUIPMENT
RURAL GAS SYSTEMS ... SEPTIC TANKS ... GRAIN BINS ... FARM EQUIPMENT and PRODUCTS OF OTHER METALS

Power
and plenty of it!
With the new, Victory Model
60 cu. ft.
SMITH AIR
COMPRESSOR



uses only
1 gallon
of gasoline an hour

SAVE 3-WAYS

SAVE TIME: The Smith is lightweight, flexible, — easy to move from one job to another. SAVE MONEY: — on original purchase price — on operating costs. SAVE GASOLINE — more important than ever before.

60 cu. ft. size (illustrated above) uses less critical material than any other standard compressor. Made with FORD MOTORS and standard parts. Repairs and parts available at any Ford garage. Automatic unloading and idling, self-starter. Wire, phone or write TODAY for complete information.

With a Ford Motor and shop facilities you can assemble your own Smith Compressor. We will furnish a Smith Compressor Head and Accessories with complete instructions for mounting.

Write for free Booklet

GORDON SMITH & CO.
INCORPORATED
430 College St. Bowling Green, Ky.

and electrical systems for recording flow at a distance when the recorder is located on a centralized panel board. Cross section photographs and line diagrams in color clarify the operation of the deaerators; illustrations are shown of various designs that are constructed to meet space limitations and operating requirements; and accessories equipment are illustrated and described. Copy on request—*Cochrane Corp., Philadelphia.*

Aluminum Alloy Scrap—One of the interesting features of the Aluminum News Letter, put out by the Aluminum Company of America, is the discussion of aluminum alloy scrap which it is said, when once contaminated with other metals, or even mixed with other aluminum alloys, is difficult to reprocess into specific commercial alloys, and thereby a considerable part of its otherwise high market value is lost. For full information write to—*The Aluminum Company of America, 2125 Gulf Bldg., Pittsburgh, Pa.*

Tractors in War—An unusually handsome booklet has been put out by the Caterpillar Tractor Co. showing the use of tractors in war.—*Caterpillar Tractor Co., Peoria, Ill.*

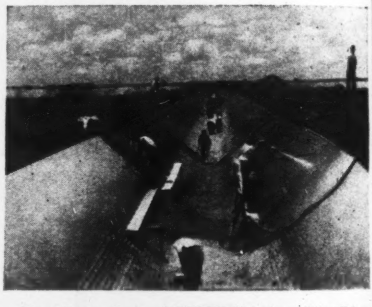
Welding Electrode Development — Announcing an entirely new development in refrigerated welding electrode design, a 6 page, 4-color bulletin has been released by the manufacturer. It completely describes the design, construction and operation of permanent electrodes with replaceable finned "Frostcaps," also adapter holders to convert any spot welder to the process. Color cuts show coolant circulation, improved installation practice, and unique method of cap replacement with electric pliers. It is said that the use of this development will conserve 90 percent of electrode copper, increase welding production, eliminate point dressing, and permit more effective cooling by cutting electrode replacement costs.—*Frostrode Products, 19003 John R, Detroit, Mich.*

Jaw Crushers—An interesting folder put out by the Diamond Iron Works, Inc., gives practical hints on the selection of a primary crusher. It points out that certain questions must be answered before it is possible to choose the right crusher. First and foremost, "What maximum capacity is required?"—because upon that will depend the size crusher which is necessary, and that, in turn, will depend partly upon the size of the rock to be crushed. If the rock must be blasted, determine whether it is cheaper to use more dynamite and blast smaller to use a smaller size

BAILY
CONCRETE
VIBRATORS

PAVEMENT VIBRATORS
Three types: *Vibrating* screed, full-width, propelled by hand-operated winch and cable or pushed ahead by finishing machine. Gasoline power plant.
Tubular internal, extending entirely across slab, mounted in front of finisher. Gasoline or electric power plant with flexible shaft drive.
Vibrating pan, full-width, carried by two-wheeled trailer behind any standard finisher. Gasoline or electric power plant.
STRUCTURAL CONCRETE VIBRATORS
1, 3, and 4 H. P. gasoline, air-cooled, 4 cycle motors; flexible-shaft drive; interchangeable vibrator heads lubricated for life. Wheelbarrow carriers.
FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS
Pioneers in Concrete Vibrators
BAILY
VIBRATOR CO.
1539 WOOD STREET, PHILADELPHIA, PA.

IN THE
GARDEN SPOT
OF TEXAS



The photo shows "GUNITE" being "shot" in a section of irrigation canal in the southern tip of Texas, for the Willacy County Water Control and Improvement District. There are 214 miles of canals and laterals, and the aggregate area of "GUNITE" is about twelve millions of square feet. See Eng. News-Record, Sept. 7, 1939.

"GUNITE" has been used for this and similar purposes for a long time, and it has many other applications. Send for our profusely illustrated Bulletin 2200.

The "CEMENT GUN" can be bought by anyone, and used without restrictions.

CEMENT GUN COMPANY
Manufacturers of the "CEMENT GUN"
ALLENTOWN, PENNSYLVANIA
WE ARE ALSO "GUNITE" CONTRACTORS
LET US BID ON YOUR WORK

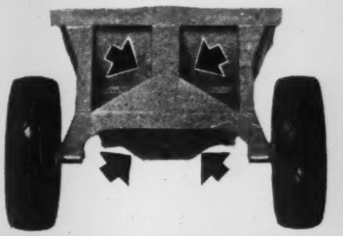
Here's How The Heil Bottom Dump Trailer Wagon Sets New Records

for Speed and Hourly Production

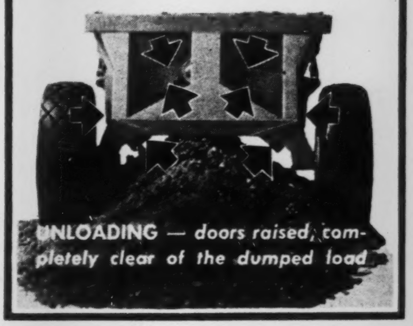
Heil engineers achieved this remarkable result by making new use of two old, proved principles of design — the clamshell principle, and cable control. The familiar clamshell is *opened* by power, *swings closed* by gravity. The operator dumps his load all at once or a little at a time, as he prefers — under complete control. And that is *exactly* what he does with this new Heil unit — the wagon that spreads like a cable scraper, that turns at will off the windrow because there are no doors dragging in the dirt, that dumps in 2 seconds and pulls away in a flash. High-clearance doors interlocked, completely synchronized, fast and positive in action. Heil Cable Scraper interchangeable on the same power unit. Investigate! Plan now for the bonus performance that makes you a stand-out against any competition. Write for bulletin.

R-11

New, revolutionary clamshell-type bottom-dump doors - power-opened



LOADED — *"clamshell" closed*



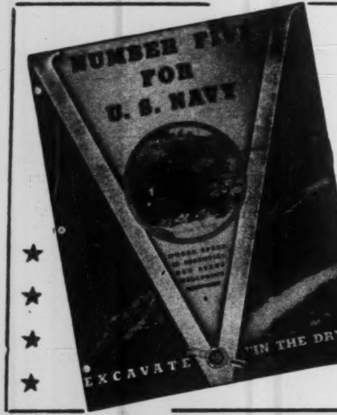
***UNLOADING** — doors raised, completely clear of the dumped load*

Dumping clearance of 35 inches with doors wide open! Doors operate on trunions *outside* the hopper body. When the dumping doors are pulled open by cable power, the doors *swing up alongside the hopper* — out of the way. (Minimum clearance with doors *closed*, 26"; rear axle clearance, 39"). Patented construction.

★ ★ ★ ★ ★
The HEIL Company is engaged in all-out war production for *Victory*

THE HEIL CO.

GENERAL OFFICES • MILWAUKEE, WISCONSIN



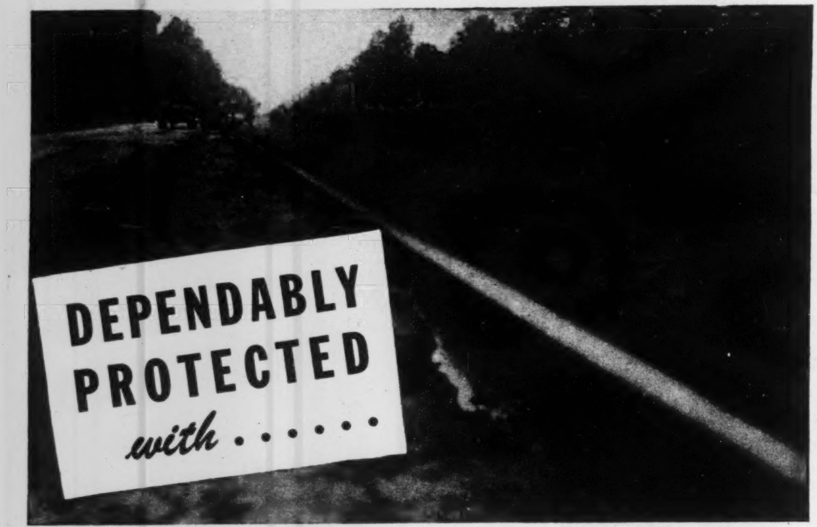
"STANG WELLPOINT EQUIPMENT"

IN WAR AND IN PEACE—Contractors and engineers "in the know" use STANG Wellpoint Equipment to keep construction jobs "In the Dry."

Write for this "V" Bulletin and read how STANG Wellpoints are *speeding the war effort*, and *cutting war costs*—just as they can speed *your* jobs and cut *your* cost, if you are a builder of drydocks, tunnels, dams, pipe lines or sewers.

FOR SALE OR RENT

JOHN W. STANG CORP.
NO. TWO BROADWAY, NEW YORK CITY
also 2322 Newton Avenue, San Diego, Calif.
2310 Calhoun Street, Houston, Texas



REILLY PIPE ENAMEL

● The vital importance of the service rendered by America's pipe lines has been sharply emphasized by war conditions. The protection of these lines is even more essential in war than in peace. The dependable protection which REILLY Enamel gives to pipe lines has been established by years of service. This tough, durable coating prevents corrosion from moisture, electrolysis, soil acids and alkalies. It resists abrasion and soil stress, and withstands wide extremes of temperature without sagging or cracking. As a lining on water lines REILLY Enamel prevents incrustations and tuberculation and insures permanent full-capacity flow.

REILLY coal tar paints give effective, economical protection to tanks, stacks, towers, structural steel and other metal surfaces.

Booklet describing these protective coatings will be sent on request.

Reilly
COAL TAR PRODUCTS

REILLY TAR & CHEMICAL CORPORATION
Executive Offices: Merchants Bank Building, Indianapolis, Indiana
2513 S. DAMEN AVENUE, CHICAGO, ILLINOIS 500 FIFTH AVENUE, NEW YORK, N. Y. ST. LOUIS PARK, MINNEAPOLIS, MINN
SEVENTEEN · PLANTS · TO · SERVE · YOU

crusher, or to blast less and use a lar size crusher. It is always wise to kn also whether a certain make crusher over or under-rated since an underra crusher is naturally capable of the sired maximum production plus an oc sional slight overload, and there is added advantage of knowing that sli differences in hardness of the rock bei crushed will not slow up or cause und burden on the crusher.—*Diamond I Works, Inc., Minneapolis, Minn.*

Fire Extinguishers—A new, education booklet entitled "Maintenance of Fi Aid Fire-Fighting Equipment" is n available. The book is divided into sections: (1) Vaporizing liquid; (soda acid; (3) foam; (4) anti-freez (5) carbon-dioxide extinguishers, a (6) charts giving complete data in co densed form as to extinguisher a engine characteristics, method of oper tion, capacity, range of stream, etc.— *American-LaFrance-Foamite Corp., E mira, N. Y.*

Heavy Duty Batteries — Containin complete replacement battery data an other engineering information, a catalo of Exide batteries for heavy duty servi is announced. The book is divided int two sections: battery service on the highway, which includes trucks, trackles trolleys, buses, taxicabs, hearses, fir apparatus, and ambulances; and off th highway service, which includes tractors cranes, shovels, roadbuilding machinery excavators, logging apparatus and compressors.—*The Electric Storage Battery Co., 19th St. and Allegheny Ave., Philadelphia, Pa.*

Electric Tool Maintenance—A new manual detailing how to get maximum service from portable electric tools is now available for engineers and constructors. This 20-page, pocket size booklet contains complete and brief instructions on the proper operation and care of all types of portable electric tools. Special attention is given to the more common and simple problems in connection with maintenance of the motor, cable, switch and brushes. "Right" and "wrong" operating methods are clearly stated and pictured with simple instructions. Full information on what to do when a tool fails to operate is also covered in this booklet, copies of which may be had by requestitng Booklet No. JE-199.—*Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill.*

Steam Trap—A 4-page descriptive folder illustrating the use of a steam trap of special design has been issued by the Connor Engineering Corp. Composed of only six parts, this trap is claimed to

THE OLD AND THE NEW TEAM UP TO *Speed Drilling!*

OLD
RELIABLE
Thor ELECTRIC MOTOR
REMARKABLE NEW
HOUSINGS OF
"THORITE"
PLASTIC

Thor "ARMORED IN PLASTIC" 1¼" PORTABLE ELECTRIC DRILL

U14K weighs only 3-1/4 pounds, measures only 8-3/16 inches overall. Speeds: 2500, 3750, and 5000 RPM.

ith its unique plastic construction, this Thor U14K ¼-inch portable electric drill is as *new* as tomorrow. s features of lighter weight, more power per pound nd new handling ease provide performance that meets e stiff demands of today's high speed, heavy duty roduction! And, beneath the plastic armor is the me-proven reliability of Thor construction: the Thor Hevi-Duty motor with its great reserve f power, high torque and remarkable stamina. For every kind of heavy duty, ¼-inch drilling, this teaming up of the ld and the new gives unparalleled results. The Thor "Armored in Plastic" drill is available now to war industries. Write for circular giving full details.

ARMY E NAVY

THOR'S 50th YEAR

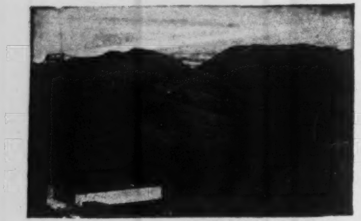
Thor *Portable Pneumatic and Electric Tools*

INDEPENDENT PNEUMATIC TOOL COMPANY

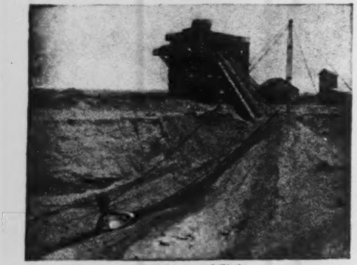
600 W. JACKSON BOULEVARD, CHICAGO, ILL.
Branches in Principal Cities

Streamlined **CRESCENT SCRAPERS**

Haul larger loads at lower costs . . .



Above picture shows a 6 cu. yd. Sauerman Scraper operating on a 450-ft. radius handling a 200,000-ton stockpile. Hourly capacity, either storing or reclaiming, is 200 tons.



Here is a 2 cu. yd. Sauerman Scraper equipped with carrier for gravity return, moving gravel from deep cut to crusher at screening plant.

ON thousands of excavating and material-handling jobs, Sauerman Crescent scraper buckets have proved their ability to dig and convey large tonnages of gravel, clay, stone, etc., at costs of a few cents per ton handled.

The secret of this efficiency is in the streamline design of this unique bucket. A Crescent scraper penetrates hard materials with the ease of a plowshare, and both in digging and conveying it requires much less line-pull than any other scraper of equal rated capacity.

For complete descriptions of the various sizes of Crescent scrapers, handling capacities, methods of operation, etc., write for Bulletin 147.

SAUERMAN BROS., INC.

532 S. CLINTON ST. CHICAGO, ILL.

FACTORY CONSTRUCTION

. . . one of Douglas Fir Plywood's most important war jobs!

DOUGLAS FIR PLYWOOD

Real Lumber

MADE LARGER, LIGHTER
SPLIT-PROOF
STRONGER

● When factories, warehouses, administration and other industrial structures had to be built *fast* for war production, many companies turned to Douglas Fir Plywood. They used this time-saving, labor-saving engineered lumber for siding, sub-flooring, sheathing, roof decking, interior paneling and concrete forms. For example, the giant West Coast aircraft plant shown above has outside walls of Exterior-type Douglas Fir Plywood . . . But factory construction is just one of Douglas Fir Plywood's hundreds of war uses — uses that, after Victory, will help this Miracle Wood serve you better and in more ways than ever before!

SEND FOR FREE WAR USE FOLDER! Douglas Fir Plywood Assn., Tacoma, Wash.

STRONGER PER POUND THAN STEEL!

be very efficient and extremely rugg
The valve mechanism (only mov
part) functions by rotating within
cylinder provided with inlet and
charge ports. It is claimed that the va
never draws away from its seat, t
preventing wear on either the seat or
face of the valve. Tables show
capacities and dimensions for vari
sized steam traps are contained in
folder, copies of which may be had u
request to—*W. B. Connor Engineer*
Corp., 114 E. 32nd St., New York, N.

Power Transmission Equipment—A c
densed, illustrated new 180-page book
showing types and sizes of power tra
mission and materials handling equ
ment has just been issued by Li
Belt Co. This booklet is particula
designed for the man ordering rep
parts, or wishing to buy parts for a n
installation. Dimensions, weights, a
other pertinent data are given on chai
sprockets, bearings, shaftings, couplin
pulleys, screw conveyors and many oth
equipment aids to constructors. T
book will be forwarded to anyone
questing it on his business letterhead.
Link-Belt Co., 307 N. Michigan Av
Chicago, Ill.

Electric Drilling Rigs—A new 57-pa
booklet has recently been issued descri
ing electric drill rigs for many drilli
problems. This booklet, illustrated wi
photos, charts and diagrams, discuss
the advantages of electric drilling a
tells where to use d-c variable voltag
rigs and where to use a-c equipmen
Typical equipment for various drilli
depths are listed for both a-c and d
drilling, and their maintenance and ca
are discussed. Also included in th
booklet is a section on auxiliary equi
ment required on drilling rigs. A cop
of this booklet, B-3038, may be secure
from Department 7-N-20.—*Westinghous*
Electric & Mfg. Co., East Pittsburgh, P

Electric Steel Castings—A valuable 40
page bulletin describing the manufactu
and application of electric furnace ste
castings is now available. Numerou
pictures and illustrations throughout th
bulletin cover many types of casting
including carbon-steel, alloy-steel, iro
and non-ferrous materials. The machin
ing, heat-treating and tempering of suc
castings is well illustrated throughou
the bulletin, which also includes valuabl
other data on castings. Copies of this
bulletin No. 801 may be secured by
writing the—*Eimco Corp., 634 So. 4th*
West St., Salt Lake City, Utah.

Corrosion-Resistant Tank Linings—The
physical characteristics of a synthetic
material impervious to oil, moisture and
most oxidizing elements are described i

Look on the roof of

The Best Heated Building in Town

ere is the symbol of heating "Con-
lled-by-the-Weather."

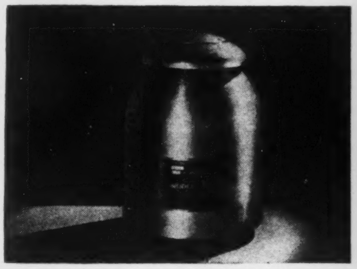
is the Outdoor Thermostat of the
ebster Moderator System, an auto-
tic central control that is saving
ecious fuel for hundreds of Amer-
's best heated buildings and releas-
much needed transportation facili-
s for other purposes.

e Webster Moderator System sup-
es steam *continuously* to all radiators,
tomatically changing the heating rate
ith changes in outdoor temperature.
"off" and "on" heating. No annoy-
"now hot—now cold" conditions.

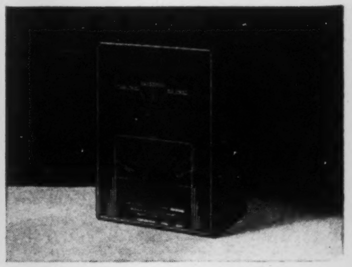
ontrol-by-the-Weather" prevents
steful overheating . . . reduces costly
indow opening in periods of mild
eather. Radiator temperatures may
ry from 212° to 150°, or even as low
90°, depending on the need for heat.

e Webster E-4 Moderator System
a steam heating control that any-
ody can understand. There are just
ur control elements—an Outdoor
hermostat, a Main Steam Control
lve, a manual Variator and a pres-
re Control Cabinet. These elements,
us small metering orifices to assure
ch radiator its share of steam, result
the highest expression of comfort
d economy in modern steam heating.

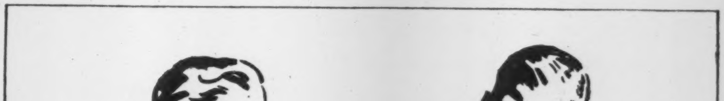
ARREN WEBSTER & CO., Camden, N. J.
neers of the Vacuum System of Steam Heating : : Est. 1888
esentatives in *principal* U. S. Cities : : *Darling Bros., Ltd., Montreal*



Outdoor Thermostat automatically changes heating rate when outdoor temperature changes.



Variator provides desirable manual operation to supplement automatic control.



For men who are planning building construction or modernization both now and after the war, we have a free book giving case studies of 268 modern steam heating installations—banks, hospitals, hotels, apartments, office buildings, industrial plants, large buildings of every type. These are reports on actual installations of the Webster Moderator System, with photographs of buildings, proof of heating comfort, savings in dollars and cents. Study this 75-page book at your leisure. Your nearest Webster Representative will call only if you invite him. Write for "Performance Facts" today.

ARMY E NAVY

Webster

Steam Heating

Ox-Cart methods are "out"

Photo by courtesy of Public Works Administration

You wouldn't attempt to buck today's competition with such a primitive outfit as that above. But if you are using the ordinary type of dump-truck equipment on hand loading jobs then you are still missing a "good bet," if you don't utilize the time-saving advantages of Brooks LOAD LUGGER.

This modern hoisting-dumping unit is the answer to manpower problems. It fits on any standard chassis and enables one truck to do the work of several by using detachable buckets, which can be loaded, hauled and dumped continuously. This method cuts out lost time waiting for load-ups, and boosts production 50% or more. *Write for Catalog #44*

LOAD LUGGER

Only 15 seconds for hoisting or dumping. For maximum economy, use 5 to 10 dump buckets with each Load Lugger.

805 Davenport Road KNOXVILLE, TENN.

Distributors in All Principal Cities

Brooks EQUIPMENT AND MFG. CO.

KERLOW

LIGHT . . . STRONG . . . SAFE

About 85% of the area of Kerlow Open Steel Flooring is open . . . allowing free passage of light, air, heat and fumes, and making it self-clearing. And Kerlow Flooring is strong, slip-proof in all directions, easily installed, and wear-resisting . . . the ideal industrial flooring.

KERLOW
STEEL FLOORING CO.
23 Mallory Avenue
Jersey City New Jersey

FREE BULLETIN Write for your copy today

KERLOW Open STEEL FLOORING

an 8-page pamphlet recently prepa which should be of interest to c structors of line pipe drains, sewers, other fixtures that are required to resistant to corrosion. Joints can welded together producing a continu one-piece lining. It will adhere firmly steel, concrete or brick with a bond excess of 300 lb. per sq. in., states producer. It is composed of non-criti materials and said to be economical cost of installation. Copies of the scriptive folder on the subject may obtained by writing to the engineer department.—*U. S. Stoneware Co., ron, Ohio.*

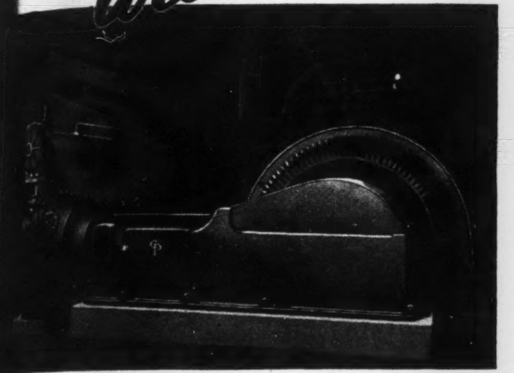
Marine Gears—A paper on "Mar Gears and Their Maintenance" by C. Waller is being distributed by the Laval Steam Turbine Co., of which Waller is vice president in charge engineering. Among other things, reprint mentions what the chief engin of a ship and his associates should kn about the gears used with steam bines in order to guard against operat troubles and shutdowns; the precauti to be observed in uncrating, assembli installing, inspecting, starting, operat and shutting down; how to care the oiling system and what kind of to use, etc.—*De Laval Steam Turb Co., Trenton, N. J.*

Blowers and Exhausters—This is a page booklet in two colors, profus illustrated, describing both single a multi-stage units of centrifugal blow and exhausters, in many sizes. The fo word includes a brief history of company's experience in building cent fugal units, together with a list of app cations, and goes on with a discussi of the advantages inherent in the cent fugal design. Operating characteristi are discussed, with curves to substanti the statements made. There are a sectional views, types of impellers, a installation and shop cuts of the vario single-stage units which comprise t line. One page is devoted to a discu sion of various control devices that pr vide suitable regulation, and anoth page contains a number of action vie of various manufacturing and testi operations. — *Roots-Connersville Blow Corp., Connersville, Ind.*

Tank Calculator—A very ingenious ta calculator, pocket size, is issued for d signers and users of A.S.M.E. code pr sure vessels and is available to enginee or executives upon request. It enabl the user to ascertain quickly the requir thickness in inches, the approxima weight of cylindrical section in poun per linear foot; approximate capac in gallons per linear foot. As to hea the required thickness in inches, appro

Compressors, too, are working hard these days—

PROPER LUBRICATION IS MORE IMPORTANT THAN EVER



Built into Chicago Pneumatic horizontal stationary compressors are force feed cylinder lubrication and a highly efficient flood system of frame lubrication. These lubricating systems require only minimum attention on the part of the operator—a few simple check-ups which, however, should be made regularly.

Additional suggestions for maintaining compressor efficiency will appear in future advertisements. Watch for them.

HOW TO GET MAXIMUM OPERATION FROM YOUR CP COMPRESSORS

Bearings will not run without oil. Keep oil in crank case at level indicated on oil level gauge (illustrated). Drain, clean, refill reservoir at least once a month — more frequently if local conditions require.

← At least once a day, check the force feed cylinder lubricator, making sure reservoir is filled to required level. Make certain that lubricator is feeding only the number of drops per minute recommended for your particular size of compressor — too much oil results in carbon formation and overheating.

★★★★★★★★★

PNEUMATIC TOOLS
ELECTRIC TOOLS
(Hicyčle...Universal)
ROCK DRILLS

CHICAGO PNEUMATIC TOOL CP COMPANY

General Offices: 8 East 44th Street, New York, N. Y.

★★★★★★★★★

AIR COMPRESSORS
VACUUM PUMPS
DIESEL ENGINES
AVIATION ACCESSORIES

AIRPAINTING

Photo courtesy Austin Co.

THE WORLD'S LARGEST TIMBER FACTORY

PAASCHE AIRPAINTING EQUIPMENT SPEEDS THE JOB.

The huge factory, a portion of which is shown above, designed and built by The Austin Company, will soon be producing airplanes. In its construction, over 30,000 tons of steel and critical materials were saved—in the painting, another important saving was effected—in man hours.

H. Knudsen & Co., painting contractors, using Paasche High Production Airpainting Units, sped the job to completion, spraying over 5,000,000 square feet at an average rate of 5000 feet per man per 8-hour shift.

Throughoout the nation and at our outlying bases, Paasche equipment is being used to speed painting of new construction and to maintain a protective coating on bridges, tanks and structures of all types. In shipyards, too, Paasche equipment is helping to get them down the ways faster. *The great speed obtained with Paasche Airbrushes solves many man-power-shortage problems.*

HERE'S WHY PAASCHE UNITS DO THE JOB QUICKER AND STAY ON THE JOB.

★ The Type CUB High Production Airbrush, sprays all types of finishing materials at top speed under perfect control. Light weight and perfect balance enable operator to work longer hours without fatigue. Built for the roughest use with all parts enclosed in machined brass body.

★ Paasche Pressure Feed Material Tanks save valuable time in material handling. The exclusive "Clamptight Cover" can be removed in 5 seconds!

★ Paasche streamlined portable Aircompressors are always "ready to roll" to supply a steady, dependable source of air. Superior multiple cylinder design assures maximum efficiency and lower maintenance cost, and more actual delivered air per horsepower used.

Specify Paasche Airpainting Equipment and get that job done quicker. Write for complete specifications, prices and information on units for every requirement.

PAASCHE AIRBRUSH COMPANY
1928 Diversey Parkway Chicago, Ill.

Paasche manufactures heavy material airbrushes for applying cement wash, asphalt materials, and other heavy coating compounds. Special units provide fast, uniform application of ground cork and similar materials.

Paasche AIRPAINTING EQUIPMENT

Manual, automatic and special airpainting equipment, airfinishing booths, pressure regulators, airconditioners for compressed air lines, air dusters and stripers.

NEED A BIG Trailer?

La Crosse Makes Them Up To 200 Ton Capacity-

★★ WRITE OR WIRE ★★

LA CROSSE TRAILER & EQUIPT. CO.
LA CROSSE, WISCONSIN U.S.A.

EPPINGER AND RUSSELL Co.

Wood Preservers Since 1878

All kinds of Structural Timbers and Lumber Pressure Treated with Creosote Oil or

DU PONT CZC Chromated Zinc Chloride

80 EIGHTH AVE., NEW YORK, N. Y.

POLES, CROSS ARMS, PILING, TIES
POSTS, BRIDGE AND DOCK TIMBERS

TREATING PLANTS
Jacksonville, Fla. Long Island City, N. Y.

mate weight of one head in pounds,
proximate capacity in gallons of
head, inside depth in inches of one hea
knuckle or corner radius in inches; a
dish radius in inches.—*Buffalo Ta*
Corp., Buffalo, N. Y.

Protecting Iron and Steel—A gui
to longer life for iron and steel produ
has been issued which explains the h
galvanizing process. According to t
National Bureau of Standards, exposu
tests conducted in various parts of t
country over a period of years are sa
to show conclusively that zinc offe
greater protection than any other co
mercially practical metallic coating.
this booklet is explained the use of zi
in this connection.—*American Hot D*
Galvanizers Association, Inc., Pittsburg
Pa.

Refrigerated Welding—Description
the Frostrode process of refrigerat
welding is covered in a 4-page bulleti
which also covers the design and ope
ating features of the welding system a
a whole. Operation of the various com
ponents of the system are discussed, in
cluding refrigerator units and permanen
welding electrodes which have replace
able tips and adapters to convert stand
ard resistance welders to use of th
refrigerated welding process. Charts o
increased production obtained by user
of the process in welding typical gauge
of aluminum alloy are shown in thi
bulletin, copies of which may be obtaine
from—*Forstrode Products, 19003 Joh*
R. St., Detroit, Mich.

Mechanical Drafting—There has recently been brought out a wall size ($16\frac{1}{2} \times 27\frac{1}{2}$ in.) reference chart, showing the basic standards in mechanical drafting. Many industrial art and educational schools are interested in such material and it is thought that such a chart would also be of material help to large defense plants conducting their own classes.—*Department F, Eberhard Faber Pencil Co.,* 37 *Greenpoint Ave., Brooklyn, N. Y.*

Another Engineering Handbook—This is a scrap book collection of fundamental engineering data such as an engineer or designer might himself assemble from various sources to obviate the necessity of poring through numerous reference books. In addition, it contains much entirely new material to eliminate time-consuming calculations. The company apparently has spared no effort to make this an outstanding handbook. Request for a copy of the book should be written on company letterhead, giving the position of the one making the request.—*Hyatt Bearings Division, General Motors Corp., Harrison, N. J.*

They last longer, perform better with Gulf Quality Lubricants and Fuels

Gulf products make a big difference on today's tough jobs

THERE'S a double squeeze today on America's construction men—every job is marked rush, and new quipment and spare parts are hard to get. So these are e orders of the day on every construction project: *make quipment operate more efficiently, last longer!*

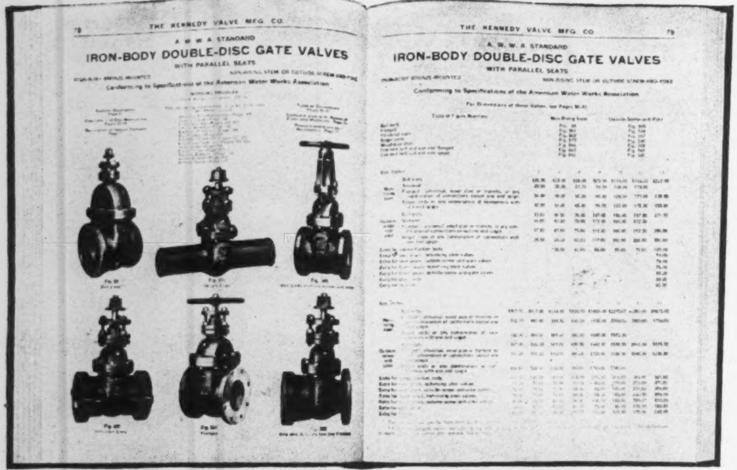
Here's how to get effective help in carrying out these rders on *your* jobs: Call in a Gulf Service Engineer and sk him to recommend the proper type and grade of ubricants and fuels for each piece of equipment you are sing. From Gulf's complete line, he will select lubriants with greater stability and lasting qualities—tough lmed lubricants that provide maximum protection to our equipment under every operating condition. And, he will recommend fuels that insure top-notch equipment performance.

Join now the hundreds of leading contractors who have standardized on Gulf quality lubricants and fuels as a job insurance measure. Write or phone your nearest Gulf office today.

GULF

GULF OIL CORPORATION
GULF REFINING COMPANY
GULF BUILDING · PITTSBURGH, PA.

When You Need Gate Valves


THE KENNEDY VALVE MFG. CO.
A. W. W. A. STANDARD
IRON-BODY DOUBLE-DISC GATE VALVES
WITH PARALLEL SEATS

look in the KENNEDY Catalog

Complete description, complete specifications, complete list prices, and complete dimensions . . . you will find all this information on A. W. W. A. Water Gate Valves in the new 240-page Kennedy Catalog.

Kennedy Water Gate Valves even exceed A. W. W. A. requirements in some particulars, and their special features of design, sturdy construction and consistently reliable service have made them widely popular in water supply pumping stations.

Write for your copy of the Kennedy Catalog

THE KENNEDY VALVE MFG. CO., Elmira, N. Y.

KENNEDY
A.W.W.A. WATER GATE VALVES

THE MOUNT VERNON BRIDGE CO.

Engineers Contractors
STRUCTURAL STEEL
RAILWAY AND HIGHWAY BRIDGES
BUILDINGS AND VIADUCTS

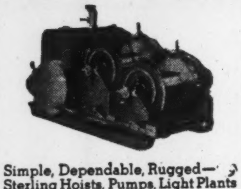
MOUNT VERNON, OHIO

STERLING QUALITY

YOU'LL GET BETTER RESULTS WITH STERLING

WRITE FOR LITERATURE

STERLING HOISTS



Simple, Dependable, Rugged—Sterling Hoists, Pumps, Light Plants are the choice of leading users.

STERLING MACHINERY, CORP.
405 13 Southwest Blvd. Kansas City, Mo

MEN AND JOBS

Fred W. Stiefel, until recently gen manager and chief engineer for fi doing heavy construction work in New York area, has organized the Stie Construction Corp. with a New Y City office at 595 Madison Ave. T organization expects to do tunnel, s way, underpinning and other heavy c struction. At present they are develop a large iron ore mine in New Y State.

J. R. Scofield has been appointed di sion engineer of the Illinois division the New York Central Railroad Syste with headquarters at Mattoon, Illino

LaVerne Hudson, who left the Illin state division of sanitary engineering enter the military service in Februa as a first lieutenant in the Sanita Corps, has been sent to Jjota. Colombi on an assignment for the Inter-America Affairs Commission.

Melvin Dobbs, formerly an engineer wi the Illinois State Division of Sanitar Engineering, and more recently with th East Side Health Unit, East St. Loui Ill., is now a first lieutenant with th Sanitary Corps stationed at Camp Gran Ill.

Frank Burrows, at one time assistant hy draulic engineer of the State Division o Water Rights, has been elected mayor o Burlingame, Calif.

E. C. Luke, Vancouver, B. C., engineer ing, has been named group captain o the Royal Canadian Air Force and senio officer in charge of personnel, Wester Air Command.

Elmer K. Nelson, former city engineer of Larramee, Wyo., has gone to Sacramento, Calif., to do special postwar planning work in investigating Sacramento valley resources. Mr. Nelson is a graduate of the University of Wyoming, where he also taught engineering.

Everett Ormsby, a civil engineering graduate of Iowa State College last year, has become a junior engineer in the United States Engineer Office of the Hawaiian department at Honolulu.

R. Preston Watts, of Boaz, Ariz., has been promoted to the rank of major from that of captain at Camp Butner, N. C., where he is director of the Post Engineer Division. As director of the Engineer Division, Major Watts is in charge of construction, water supply, sewage dis-

FIR-TEX Absorptive Form Liner

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R-TEX Absorptive Concrete Form Liner is a highly absorptive ed board, with a chemically treated face which resists bonding.

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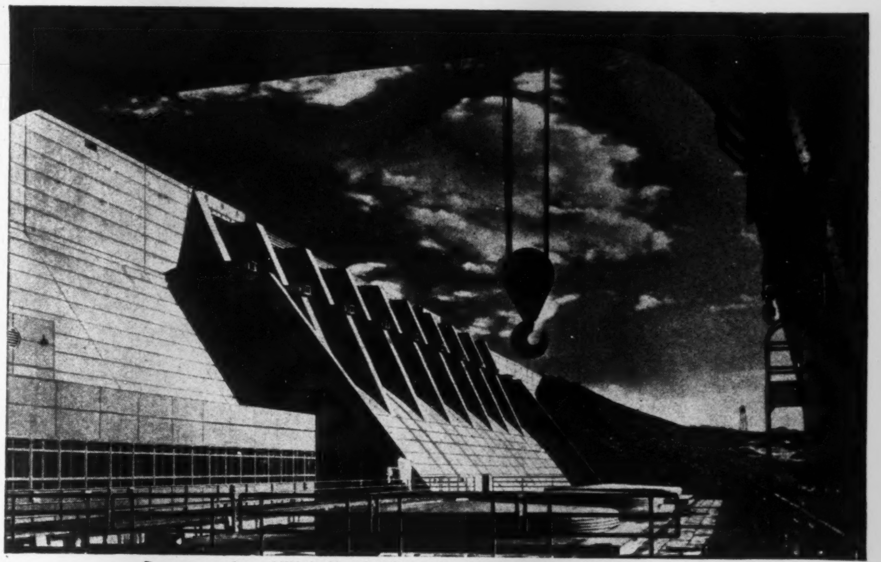
he action of the Fir-Tex Liner like that of a vacuum cleaner. It orbs all excess air and water acent to surface. The removal of bbles permits the cement to flow o those spaces so that this surface s solidly into a smooth attractively tured mass of extreme density d resistance to moisture. This structal change in the concrete extends a depth of about 1¼ inches from face. Not only has the structure en given architectural beauty, but weather resistance has been so atly increased that eminent eneers have referred to its surface "case hardened".



Downstream face of TVA's Cherokee Dam, showing powerhouse and the high spillway.

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See section 3

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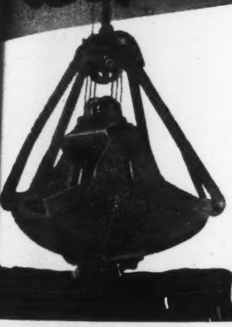

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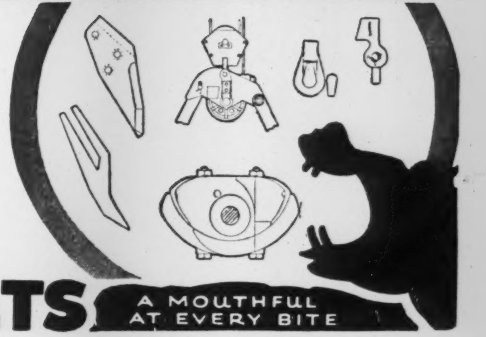

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posal, repairs and maintenance on
post.

David L. Richardson, of Raleigh, N.
who studied engineering at North Ca
lina State College, has been promot
to the rank of first lieutenant in
Army Corps of Engineers at Ca
Campbell, Ky., where he is a compa
commander.

Edward H. Sheppard, of Roscommo
Mich., has resigned as a member of t
Roscommon County Road Commission
accept appointment as its superintende
He succeeds Carl Richardson, resigne
O. M. Arthur of Prudenville was
pointed to take Mr. Sheppard's place
the commission.

J. A. Lenoir has been promoted to di
trict engineer with the Quebec Provi
cial Department of Roads. Mr. Leno
was graduated in civil engineering fro
the Ecole Polytechnique of Montreal
1922.

William Love has been appointed supe
intendent of the Mechanicsburg, O
waterworks and sewage disposal syste
by the board of public affairs, succeed
ing Robert Venrick, resigned.

Thomas L. Robinson of New Bern,
C., has just been made supervisor of th
maintenance-of-ways department of th
Atlantic and East Carolina Railway Co

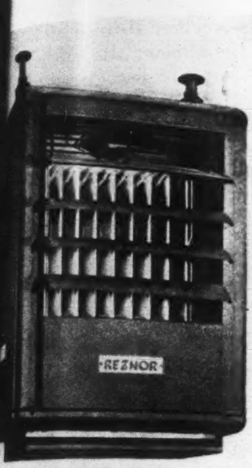
Max W. King, for the past six years superintendent of construction for the Mexican National Irrigation Commission on the El Azucar Dam has been transferred to Mexico City as consulting engineer for construction of their work throughout Mexico.

L. R. Chandler, stationed at Pendleton, Ore. for the last four years as state highway department resident construction engineer, has resigned to accept a U. S. Navy commission. He has been succeeded by Earl Bickmore, veteran member of the highway department who was formerly stationed at Ontario.

Martin McMurray, formerly connected with the Arkansas State Highway Department, has gone to Edmonton, Alta., to accept a position as associate engineer on the Alcan Highway.

E. A. Kemmler, city highway engineer of Akron, Ohio, from 1918 to 1931, has returned to city hall at 73, to help out during the war-induced shortage of engineers. Mr. Kemmler spent 38 years in public work and an additional four years for private firms.

Maj. Richard E. Froiseth, post engineer



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"GAS HEATERS EXCLUSIVELY SINCE 1888"

at Camp Joseph T. Robinson, Little Rock, Ark., has been promoted to the rank of lieutenant colonel. He entered the service at Houston, Texas, and assumed his duties as camp engineer Oct. 22, 1942.

R. P. Murphy, who was stationed at Jacksonville, N. C., for two years as one of the officers in charge of construction of the New River Marine Base, has recently been promoted from the rank of lieutenant to that of lieutenant commander in the United States Naval Reserve. He is now assigned to Camp Perry near Williamsburg, Va.

Maj. Harold B. Gottas, chief engineer, division of health and sanitation, coordinator of Inter-American Affairs, has returned from South America, where he was working on the health and sanitation projects in a number of different countries.

J. R. Bonnier and **C. E. Campeau** have been appointed to the Town Planning Commission, the City of Montreal, Que.

S. M. Percival, Albermarle, N. C., assistant superintendent of Yadkin Railroad, has entered the army with the rank of captain in the company formed of Southern Railway men to have responsibility for maintenance of rail transportation for the army.

Williams B. House, senior engineer for the Struck Construction Co., Louisville, Ky., has been commissioned a captain in the resources and production division of the Army Service Forces, Washington, D. C. Captain House received a civil engineering degree at Pennsylvania State College.

J. E. Hannum has been appointed acting dean of the school of engineering at the Alabama Polytechnic Institute at Auburn, Ala. He succeeds the late John J. Wilmore who had headed this division of the college for 55 years. Dean Hannum has served as assistant dean and professor of engineering at Auburn since 1938. He went there from Chicago where he was with the Association of American Railway Engineers.

Maj. Chris Sherlock, former Alabama highway director, is on active army duty at Dawson Creek, B. C. At Skagway, Alaska, Major Sherlock was operations officer on construction of the Alcan highway and at Dawson Creek he will be liaison officer and coordinator of roads for the U. S. Corps of Engineers.

Granville M. Reed has been appointed assistant chief engineer of the E. I. du Pont de Nemours & Co. For about 2½ years Mr. Reed has been manager of the

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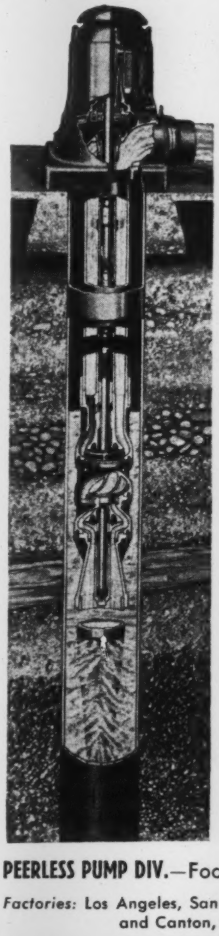

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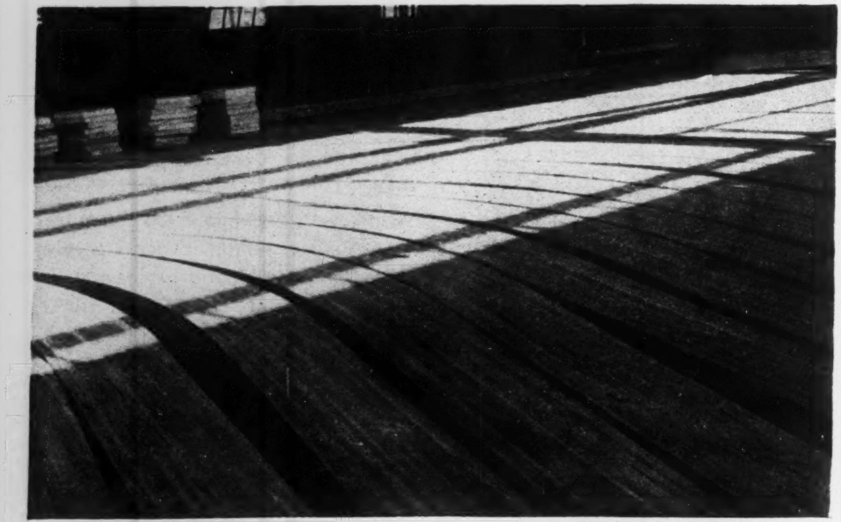

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War Construction Divi- n of the E
neering Department. He succeeds R.
Moore, who has been commissione
lieutenant commander in the Un
States Naval Reserve and is now
tioned at Norfolk, Va.

Jerome C. Alderman, formerly a li
tenant with the U. S. Engineers has b
made a captain in that unit. He is
tioned at Camp Chaffee, Fort Sm
Ark., as assistant to the area engineer

George T. Andrews, formerly a li
tenant with the Little Rock office of
U. S. Engineers, has been made a c
tain and is assistant to the area engin
at the Suttgart Army Air Field, Stu
gart, Ark.

Frank A. Howard has retired as consu
ing engineer of the Erie Railroad Co
structures division in Cleveland, Oh
Mr. Howard joined the company in 18
and served as engineer of structures fr
1906 until last February, when he w
made consultant in the department.

J. J. Goddard, Birmingham, Ala., h
been named chief equipment superi
tendent of the Alabama highway depa
ment.

John Berry, county engineer of Tam
County, Ia., has reported for duty
Camp Perry, Va. He recently enliste
in the Seabees and received a warra
officer rating. **Donald Child,** who wa
the assistant engineer, is now the count
engineer.

Herbert F. Wickenkamp, county eng
neer of Audubon County, Ia., has bee
granted a leave of absence to go t
Alaska with the Lytle-Green Companie
on the Alcan highway project.

H. M. Smith, county engineer of Ko
suth county, Ia., has been granted a leav
of absence to work on the Alcan high
way project. **C. E. Chubb** will hav
charge of the engineer's office in his ab
sence.

Col. Cecil R. Moore, former U. S. dis
trict engineer at Portland, Ore., is one
of the officers nominated by the President
for promotion to brigadier-general. Col
onel Moore is now somewhere in Eng
land on active duty. He was district en
gineer in Portland from August 1, 1938
to April 4, 1942.

Lt. Col. Hugh S. Harpole, head of the engineering division of the Jeffersonville Quartermaster Depot, Ky., has been promoted to colonel. He organized the engineering division at the Jeffersonville Depot, specializing in research and development.

MEETINGS

ERICAN WATER WORKS ASSOCIATION, nal meeting Hotel Statler, Cleveland, o. June 15-18.

CIETY FOR THE PROMOTION OF ENGI-ERING EDUCATION, 50th anniversary eting, Chicago, Ill., June 18-20.

ERICAN SOCIETY FOR TESTING MA-IALS, 46th annual meeting, Hotel Wil-m Penn, Pittsburgh, Pa., June 28-y 2.

REGIONAL AND LOCAL MEETINGS

NNSYLVANIA SEWAGE WORKS ASSOCIA-N AND PENNSYLVANIA WATER WORKS ERATORS' ASSOCIATION, Penn Harris tel, Harrisburg, Pa., June 8-9.

Elections and Activities

FFICERS of the Florida Engineering ciety for the current year have been cted as follows: J. Wiley Keck, Miami, esident; R. E. Wendt, Jacksonville, st vice-president; Capt. Edmund Fried-und, Jacksonville, second vice-presi-

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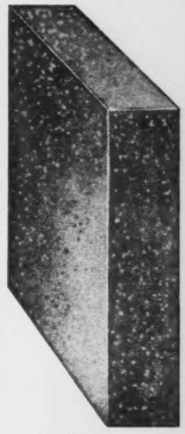

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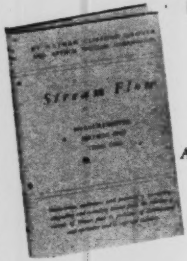

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To help engineers in the control, utilization, or administration of river waters—this book treats primarily of the instruments, equipment, and processes used to obtain stream-flow records. It thoroughly covers field work related to the systematic collecting of records of river discharge and runoff, and gives the office procedures utilized in computing, checking, and preparing such records for industrial purposes. Throughout, numerous references are made to current engineering literature.

SCOPE OF BOOK

The first part of the book shows the value of records in planning for stable local or regional development. Chapters 8-14 explain how to select sites for gaging stations—establish, equip and operate them. Next a thorough description of methods of computing results—and last how stream gaging is financed and organized in this country.

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dent; Dr. W. H. Beisler, Gainesville, secretary; Raymond Chase, Jacksonville, treasurer. New members of the board of directors are E. S. Fraser of Tallahassee and A. P. Michaels of Orlando.

The Connecticut Society of Professional Engineers will be headed during 1943 by A. Sidney Lynch of West Haven. Other officers chosen are Col. J. D. Skinner, Bridgeport, first vice-president; Herbert Scott-Smith, Waterbury, second vice-president.

Leet M. Denton, head of the Denton Construction Co. of Detroit, Mich., was elected president of the Michigan Road Builders' Association at its recent annual meeting. Other new officers are Ford Sargent, president of the Bridgeport Core Sand Co., Saginaw, vice-president; Herman Holmes, Crystal Falls road contractor, Upper Peninsula, vice-president; A. H. Fry of Fry & Kain, Lansing, secretary-treasurer.

R. W. Gamble, Milwaukee superintendent of street construction and repair, has been re-elected president of the municipal division of the American Road Builders' Association for a fourth term.

Robert Morris has been elected to membership in the Clarksburg, W. Va. water board for a term of six years.

The County Highway Officials Conference of Division 3, of Wisconsin, has elected the following officers: President, R. B. Bieri; vice-president, E. M. Bird, and secretary-treasurer, E. Berkedal.

D. B. McCrary, chairman of the North Carolina State Highway and Public Works Commission, has been appointed on the board of directors of the Southeastern Association of State Highway Officials. W. N. Rees of the Tennessee Department of Highways has been elected secretary-treasurer of the same association.

The Western Society of Engineers, Chicago, Ill., reports election of C. Earl Webb, division engineer of the American Bridge Co., as president for the year beginning June 1; vice-presidents, P. R. Elfstrom and Henry T. Heald; trustees, Paul Hansen and H. C. Townsend; members of Washington Award Commission, F. H. Lane and O. W. Eshbach.

E. O. Turner, professor of civil engineering at the University of New Brunswick, was elected president of the Association of Professional Engineers of New Brunswick at the annual meeting of the association. J. T. Turnbull, district highway engineer, Department of Public Works of New Brunswick, was elected vice-president.

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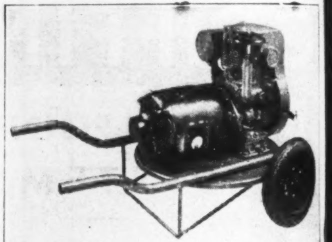

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